

THE UNIVERSITY
OF ILLINOIS
LIBRARY

595.7

Il 6

v. 16

BIOLOGY

NATURAL
HISTORY
LIBRARY

Aug 17.50

SEP 19 1907

THE UNIVERSITY
OF ILLINOIS
LIBRARY

595.7
Il 6
v. 16

BIOLOGY

NATURAL
HISTORY
LIBRARY

Univ. of Ill. Lib. Call Slip

Address _____

Name _____

Title _____

Author _____

Overdue books are subject to
a fine of 2 cents a day.

SEP 19 1907

SIXTEENTH REPORT

26
8

OF THE

STATE ENTOMOLOGIST

ON THE

NOXIOUS AND BENEFICIAL INSECTS

OF THE

STATE OF ILLINOIS.

FIFTH REPORT OF S. A. FORBES.

FOR THE YEARS 1887 AND 1888.

SPRINGFIELD, ILL :
SPRINGFIELD PRINTING COMPANY, STATE PRINTERS.

1890

595.7

I. 2. 6

Vol. 16

Nov. 14/12

CONTENTS.

	PAGE.
List of Descriptions.....	V
Letter of Transmittal.....	VII
General Record for 1887 and 1888.....	IX
Studies on the Chinch Bug. II.	1
Chinch-Bug Injury Reported by Townships, 1887.....	3
Influence of Excessive Drouth.....	5
Effect of Abandoning Corn as a Crop.....	5
Successive Abandonment of Corn and Wheat.....	6
Secondary Effects of the Abandonment of Wheat.....	6
Relations of the Area of Wheat and other Crops to Chinch-Bug Injury.....	7
Collection of Data.....	8
Study of Data.....	9
General Remarks upon the Tables.....	10
Injury to Corn as Compared with Acreage in Wheat and other Grains (Tables I-IV)....	11
Injury to Grass as Compared with Areas in Wheat and other Crops (Tables V-VIII)....	16
Damage to Small Grain as Compared with the Area in Wheat and other Crops (Tables IX-XII).....	19
Comparison of the Crops for 1886 and 1887.....	21
Injury to all Crops combined, compared with average of each (Diagrams I-VI).....	22
Discussion of Diagrams.....	29
Summary of Current Opinion.....	32
Experiments.....	35
Insecticides.....	37
Barriers to Migration.....	43
Starvation Experiments.....	44
Contagious Disease.....	45
Miscellaneous Notes and Observations.....	50
Summary and Conclusions.....	53
The Corn Bill Bugs.....	58
Analysis of Literature.....	59
Description of Genus.....	63
Key to Illinois Species.....	63
Immature Stages.....	65
Distribution.....	67
Life Histories.....	67
Injuries to Vegetation.....	69
Natural Enemies.....	71
Remedies.....	71
Economic Bibliography.....	72
Observations of the Food of the Snout Beetles (Rhynchophora).....	75

431897

Nov 23 '19 Nat. Hist. Survey Vol. 16 Continuation.

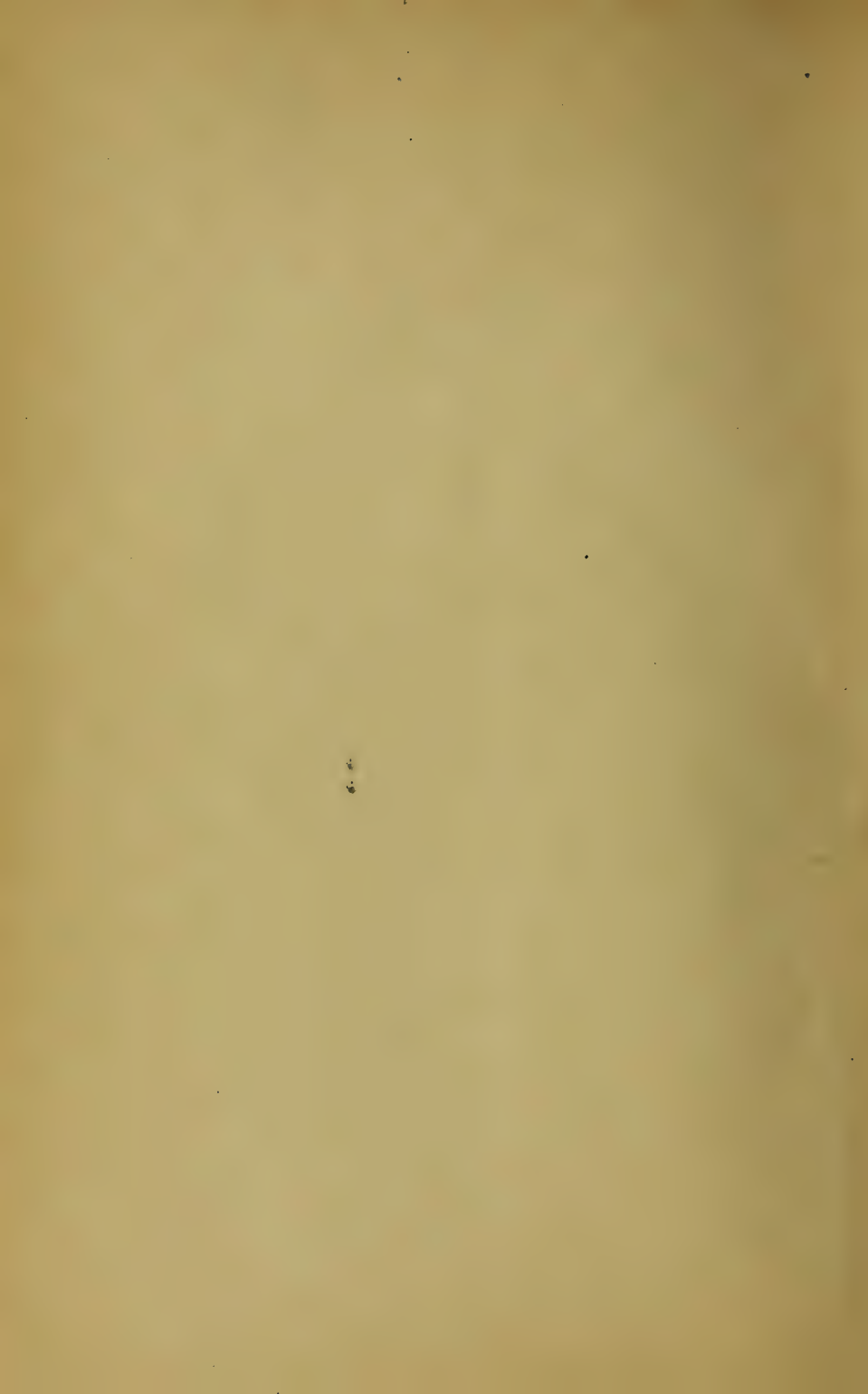
	PAGE.
The Meadow Maggots or Leather-Jackets.....	78
Description.....	80
Life History and Injuries.....	81
Notes on Cutworms.....	84
The W-marked Cutworm.....	85
Description of Larva.....	85
The Spotted Cutworm.....	86
The Chocolate-striped Cutworm.....	87
Description of Larva.....	87
The Dingy Cutworm.....	88
Description of Larva.....	88
The Western Striped Cutworm.....	89
The Clay-backed Cutworm.....	89
Habits and Life History.....	90
Description of Larva.....	92
Parasites.....	93
The Greasy Cutworm.....	93
The Variegated Cutworm.....	93
Description of Larva.....	94
The Pink-backed Cutworm.....	95
Description of Larva.....	95
The Bristly Cutworm.....	95
Description of Larva.....	96
The Glassy Cutworm.....	96
The Yellow-headed Cutworm.....	97
The Burrowing Web Worm.....	98
Description of Larva.....	99
Description of Imago.....	100

APPENDIX.

Economic Bibliography of the Chinch Bug.....	1-122
----------------------------------------------	-------

LIST OF DESCRIPTIONS.

1. The Genus *Sphenophorus*, p. 63.
2. *Sphenophorus minimus*, n. sp., p. 65.
3. *Sphenophorus ochreus*, larva, p. 66.
4. *Sphenophorus parvulus*, larva, p. 67.
5. *Tipula bicornis*, Loew: larva, pupa, imago, p. 80.
6. The W-marked Cutworm (*Agrotis clandestina*, Harr.), larva, p. 85.
7. The Chocolate-striped Cutworm (*Agrotis bicarnea*, Guen.), larva, p. 87.
8. The Dingy Cutworm (*Agrotis subgothica*, Haw.), larva, p. 88.
9. The Clay-backed Cutworm (*Agrotis morrisoniana*, Riley; *A. gladiaria* Morr.), larva, p. 92.
10. The Variegated Cutworm (*Agrotis saucia*, Hubn.), larva, p. 94.
11. The Pink-backed Cutworm (*Mamestra meditata*, Gr.), larva, p. 95.
12. The Bristly Cutworm (*Mamestra renigera*, Steph.), larva, p. 96.
13. The Yellow-headed Cutworm (*Hadena arctica*, Boisd.), larva, p. 97.
14. The Burrowing Web-worm (*Pseudanaphora arcanella*, Clem.): larva, p. 99; imago, p. 100.
15. *Gænogenes mortipennella*, Gr., p. 101.



LETTER OF TRANSMITTAL.

OFFICE OF STATE ENTOMOLOGIST,
CHAMPAIGN, ILL., Dec. 20, 1888.

To his Excellency, RICHARD J. OGLESBY, Governor of the State of Illinois:

SIR: I have the honor to transmit herewith my fifth report as State Entomologist of Illinois,—the sixteenth of the series from the office,—presenting such part of the results of our work during the years 1887 and 1888 as are now in condition for final report.

Respectfully submitted,

S. A. FORBES, *State Entomologist.*

GENERAL RECORD FOR 1887 AND 1888.

The most remarkable items of the entomological record for the two years covered by this report are the continuance of the CHINCH-BUG outbreak mentioned in my last report, an enormous eruption of CUTWORMS,—beginning in Southern Illinois in 1887 and rising still higher and extending throughout the State the following year,—and the scarcity of the HESSIAN FLY after the spring of 1887, in the region commonly infested by it.

The most noticeable horticultural insect was a species of yellow THRIPS (*T. tritici*) excessively abundant in strawberry fields in 1887, and charged with doing serious damage there. It was scarcely less numerous in 1888, but the season being more favorable, fewer complaints of injury were heard.

A still diminishing abundance of the EUROPEAN CABBAGE WORM (*Pieris rapae*) was noticeable in both years, due, doubtless, to causes previously mentioned,—the increasing prevalence of disease and the further development of parasitic enemies.

Various species shared in the CUTWORM attack upon both garden and farm vegetation, as has been reported at length on another page, but the most abundant in 1888 was one new to economic entomology,—the CLAY-BACKED CUTWORM, *Agrotis morrisoniana*.

The ARMY WORM was locally reported from a few counties of southern Illinois in spring and early summer, but in terms insufficient to distinguish it from cutworms of similar appearance. One of the latter especially, the clay-backed cutworm, was so generally mistaken for the army worm that little reliance can be placed on these statements.

Another species, new to economic entomology, is a very destructive PLUM BORER sent me from Sangamon county in 1887, larvæ of which were bred to the pyralid moth *Euzophera semifuneralis*, Walk.

In 1888 lawns and meadows of Central Illinois suffered (especially the former) from unusual numbers of ROOT WEB WORMS, or "grass web worms," as they have been variously called, the most abundant species of the season being *Crambus exsiccatu*s; *C. fuscicostellu*s was also common, and both were bred from corn. *C. zeëllu*s, on

the other hand, was rare. From a correspondent in Carroll county in the northern part of the State, I learned that these insects have been so numerous there for several years as to compel the replanting of most of the corn on sod.

The practice of spraying apple-trees in spring to protect the fruit from the CODLING MOTH, or apple worm, is now rapidly becoming general, based largely in this State on the experiments and recommendations of this office as published in our Bulletin No. 1.* The results for 1887 were generally very encouraging, but those for 1888 were less decisive, owing to an extraordinary scarcity of the insects themselves, especially in Central Illinois. This was evidently due to the occurrence in 1888 of an unusual apple crop following a season of unusual scarcity of this fruit.

A new and peculiar insect observed by us for several years, and known in the office as the BURROWING WEB WORM, occurs abundantly in grass, and in corn after sod, not in numbers, however, so far as now known, to be a serious enemy to the latter crop. This species was bred in 1888 to a moth, *Pseudanaphora arcanella*, described elsewhere in this report. A less common species of similar habit was also bred in 1888, and proved to be a *Cænogenes*, described on another page as *C. mortipennella*, Grote.

The history of the HESSIAN FLY during the past two years exhibits anew the effect of drouth upon the multiplication of that species. Many of the wheat fields of Southern Illinois in regions which had been free from the fly the preceding year, showed it in such numbers at harvest time in 1887 as to make it seem probable that the following crop would suffer heavily; but a severe mid-summer drouth following, prevented almost entirely the growth of volunteer grain, and very probably also dried up the larvæ and pupæ of the fly in the field. As a consequence, these neighborhoods in 1888 were almost absolutely free from evidence of attack, although in adjacent counties, where the drouth was less severe, the fly was noticeably abundant in the fall of 1887 and in the following spring.

Experimental sowings in 1887 and 1888, made to trace the summer history of this insect, failed because of the drouth,—in the former year completely, in the latter partially,—only the latest planting growing. One plot, sown at Albion, Edwards county, July 28, started slowly, and was heavily attacked by chinch bugs and grasshoppers. There no Hessian flies were detected August 24, but by September 13, larvæ of almost all ages occurred in great abundance, and by the 18th a few had formed fresh puparia. Transferred to the office at Champaign and kept in the open air,

*The method of field application now most commonly used differs widely from that of my published experiments. In the latter, the finest possible spray was applied by passing the nozzle about through the foliage of the tree. In the common orchard practice a much coarser spray is thrown from beneath, through a short tube, with sufficient force to reach the top of the tree after leaving the nozzle. A greater amount of water being thus applied, a smaller proportion of the poison is necessary. More than one pound to two hundred gallons is superfluous, and may be injurious, whereas in my own experiments we found a pound to fifty gallons harmless.

the first imago (a female) emerged October 9; a male, October 10. October 16, two more females appeared and another male; October 23, another male; October 26, three males and a female; October 27, one female and three males. On a final search in the cage, made November 12, a female was found dead, with eggs near her. Compared with our previous record, as presented in the Fifteenth Report and in my Office Bulletin No. 3, these data merely bring the appearance of this autumnal brood about ten days earlier. An attempt to secure fertilized eggs and rear larvæ from the imagos hatched as above, failed,—probably because the small number of specimens reared and their scattered appearance prevented copulation.

Another dipterous insect (a TIPULID LARVA), brought to the front in a new relation by the drouths of 1886 and 1887, was first obtained by us from meadows in Edwards county in the fall of 1886, where it had shared largely, at least, in the destruction of a field of clover. The feeding habits of this species, and the extent of its injuries were made out by us in 1887, as will appear in the body of this report.

The same conditions which encouraged the multiplication of web worms in 1887 and 1888 gave rise during the former year to an extraordinary number of WHITE GRUBS, especially in lawns. Experiments made at this time on the University lawn demonstrated the possibility of killing the grubs in the earth by a free use of the kerosene emulsion, but at an expense considered excessive by the horticultural foreman. This standard species is rapidly rising in importance as a corn insect in Central Illinois, evidently breeding freely in corn, as shown by our own observations and by correspondents' reports. A general destruction of the beetles by light-traps will probably be necessary in some of the worst infested districts.

Among minor injuries by beetles we noticed a habit—not hitherto reported—of one of the LADY BUGS, *Anatis 15-punctata*, which was repeatedly observed burying itself in the pulp of ripe cherries on the trees.

Another coleopterous species detected in a new mischief is the PALE STRIPED FLEA BEETLE, *Systena blanda*, sent us from Southern Illinois as the most common and destructive melon insect.

From granaries and elevators at Shawneetown, at Albion, and in Central Illinois, I received during the fall of 1887 several lots of an insect larva reported as destructive to stored grain. This proved to belong to a species of beetle (*Tenebrioides mauritanica*) of the family Trogositidæ, mentioned in the earlier reports of this series by both LeBaron and Thomas, and by them regarded as carnivorous only—a conclusion in which they followed eminent European authorities. Our observations show, however, that this supposition is an error, as the larvæ placed in confinement in boxes of

grain fed freely on both wheat and corn. In December, in Edwards county, they were boring holes in the sides of the bin as if for transformation; and adults occurred with the larvæ in considerable abundance in May of the following year.

One of the most remarkable features of the recent agricultural development of the State is the organization of extensive drainage operations and the opening up to cultivation of great tracts of swamp land. As the original vegetation of these lands is peculiar, the first crops raised there are exposed to peculiar insect attack by species native to the swamp grasses, and I have watched with interest not unmixed with apprehension the entomological consequences of this improvement. A marked instance of possible mischief of this kind presented itself in the summer of 1888, in the form of an attack on corn and millet in one of these drainage districts, by a SNOUT BEETLE (*Sphenophorus ochreus*) whose breeding habits and history were at the time unknown. A full account of the observations and experiments made in the investigation of this species is given in a separate article; and with this I have incorporated considerable new information concerning other injurious species of this genus.

Abundant among the chinch bugs (whose continued devastations in Southern Illinois have called for very full treatment in this report) was a species occasionally noticed by economic entomologists known by them as the FLEA NEGRO BUG (*Thyreocoris pulicarius*). Its extraordinary abundance in wheat fields at harvest time in 1887 and 1888 had no visible connection with any injury to grain, and experiments reported in another article show that it fed rather upon certain abundant weeds.

Injuries done by the CORN ROOT LOUSE (*Aphis maidis*? Fitch) were apparently neither more nor less abundant than in recent years. Notable progress was made in the determination of obscure points in the life history of this species, some of them opening the way to experimental work for its extermination. The supposed aerial form of this louse, which appears in mid-summer upon the leaves of the corn, has been unusually rare during the last two years—possibly because of the hot and dry weather, so intense in 1887 as to whiten and kill, by a sort of sun-stroke, innumerable leaves of corn in thrifty fields.

The common GRASSHOPPERS, so abundant in 1885 and 1886, were rarely heard from in the period covered by this report, a few complaints from Southern Illinois—especially in 1888, from the extreme southeastern part of the State—being all the reports of noticeable damage which reached this office. At Centralia a five-year-old orchard was badly hurt by them in 1888, and at Shattuc, meadows were damaged in 1887. The species involved were *Pezolellis femur-rubrum* and *P. differentialis*—the same as those most abundant in Northern Illinois three years before.

Our common WHITE ANT (*Termes flavipes*) has been several times reported to me for its injuries to buildings and other wood-work. A large portion of one side of a small farm house in Putnam county was eaten out by it in 1887, and a small granary was nearly destroyed on the same premises; and in 1888 a similar occurrence was reported from Varna, Illinois, where the wood-work of some windows and the supports of a heavy chimney had been completely destroyed.

STUDIES ON THE CHINCH BUG.* II.

(*Blissus leucopterus*, Say.)

The economic entomology of this State has been distinguished, during the last four years, by the longest period of continuous chinch bug devastation known in the history of that insect; but as evidences of the disappearance of this outbreak are now (September 30) beginning to accumulate, it is perhaps not too soon to write its history.

Its beginnings were apparent in 1885, when noticeable injuries to corn were reported from ten counties of Southern Illinois.† In 1886, thirty counties of that region were seriously damaged, Washington county (about the center of destruction) being perhaps worst infested. In 1887 the loss was severe in thirty-eight counties of the southern district, and very noticeable in thirty-seven others of Northern and Western Illinois‡; while in 1888 small grain and corn were heavily infested throughout all the southern counties, favorable weather alone enabling the crops to withstand the injury better than the year preceding. The attack was now considerably diminished in the center of the affected area, but farther to the east, in Clay, Richland, and Crawford counties, it was much heavier in the beginning of the season than the preceding year, its force decreasing, however, with the disappearance of the first generation. On the extreme southern borders of the State, on the other hand, it continued with undiminished severity, the damage done in 1888 being greater than that in 1887,—greater in Pope and Pulaski counties, I was informed, than ever before since their settlement. There was thus apparent a wave-like propagation outward from the center above mentioned, the crest of the wave of increase requiring two years to pass from Washington county to the Ohio River. A similar gradual increase northward was demonstrated by a comparison of the numbers of chinch bugs in early spring of 1887 with those of the summer and fall, in the counties of Montgomery, Christian, and Shelby.

*For Article I. of this series, see 12th Report of the State Entomologist of Illinois, 1882, pp. 32-63.

†See "Miscellaneous Essays on Economic Entomology" in Appendix to Transactions Department of Agriculture, Illinois, 1885, (vol. 23), p. 23.

‡See table of injuries by counties on pp. 5 and 6. The loss in Illinois was computed for 1887, by J. R. Dodge, Statistician of the U. S. Department of Agriculture, at \$11,840,000. (See report of the Commissioner of Agriculture for 1887, p. 56.)

The recent wide-spread appearance of three destructive contagious diseases of the chinch bug, and a consequent diminution of its numbers, makes it seem at last unlikely that any extraordinary loss will follow next year in the territory which has been so long infested.

The present account will be limited chiefly to the most peculiar features of this eruption, and to the new knowledge gained by a careful study of its course.

The following table of loss by the chinch bug in Illinois during the year 1887 (when its injuries were most severe) is derived from assessors' reports to the office, made as explained under another head. The figures against the name of each county indicate the number of townships from which was reported the grade of loss indicated by the word at the head of the column; and the number of townships heard from in each county is shown by the sum of the figures against the name of that county in all the columns for each crop.

Chinch Bug Injury Reported by Townships, 1887.

COUNTIES.	To Small Grain.						To Corn.						To Grass.					
	None.	Little.	Moderate.	Great.	Very Great.	Complete.	None.	Little.	Moderate.	Considerable.	Great.	Very Great.	Complete.	None.	Little.	Moderate.	Great.	Very Great.
NORTHEASTERN.																		
Boone.....	3	4					5	1	1					6	1	1		
Cook.....	2	2	3				2	2	1	2				5	1	1		
DeKalb.....	10	1					9	2						11				
DuPage.....	5	2					6	1						6	1			
Grundy.....	6	3					5	3	1					8		1		
Kane.....	6	1					6	1						6	1			
Kendall.....	3	3					5	1						4				
Lake.....	3	1	1				3	2						6		1		
LaSalle.....	9	7	1	1			13	4	1					16	2			
McHenry.....	9						9							16				
Will.....	10	2	2	1			9	3	3					13	2			
Total.....	66	26	5	3	1		72	20	2	7				90	7	3	1	
NORTHWESTERN.																		
Bureau.....	8	3	1				10	1	1					11		1		
Carroll.....	8	2	1				8	2	1					11				
Henry.....	6	6	2	3	2		12	4	2	1				16	2		1	
Jo Daviess.....	1	3				1	3	3	1	2				6	2	1		
Lee.....	9	7	1				12	5						13	3	1		
Mercer.....	3	2	2	1			3	2	3					3				
Ogle.....	10	6	2				14	4						13	4		1	
Putnam.....	2	2					3	1						7				
Rock Island.....	1	1	1		2	2	1	1	2	1	1			5		2		
Stephenson.....	1	3	3	2	1		2	5	1	2				7	2		1	
Whiteside.....	7	4		1			7	3	1					10	1			
Winnebago.....	9	2	1				11	1						12				
Total.....	65	41	13	11	5	2	86	32	8	9	2	1		116	14	5	2	1
WESTERN.																		
Adams.....	11	2					10	2	1					12	1			
Brown.....	4						3	1						4				
Calhoun.....		8							8						8			
Fulton.....	10	3					10	3						12	1			
Greene.....	8	4	1				2	2	4					4	1	1	2	
Hancock.....	13	2					8	7						11	4			
Henderson.....	3						3							3				
Jersey.....	2	3	1				1	1	2					3	2	1		
Knox.....	4	1	1	2			5	2	1					6	1	1		
McDonough.....	8	2	1				5	3	1					8	3			
Morgan.....	4	1	1				5	1	1					4	1	1		
Pike.....	9	6	1				8	5	2	1				14	1	1		
Schuyler.....	10						7	3						9		1		
Scott.....	3	1					4							4				
Warren.....	8	2					8	2						8	2			
Cass.....		5						5						5				
Total.....	92	28	15	5			78	34	9	15	2	2		107	25	5	3	
MIDDLE.																		
Christian.....	6	3	1		1		3	5		2	1			9	1		1	
DeWitt.....	6	1					6		1					7				
Livingston.....	16	3					16	3						18	1			
Logan.....	5				1		4	1			1			5		1		
Macon.....	9						9							9				
Macoupin.....	6	2	3	3			4	1		2	2	3		6	8			
Marshall.....	6	2	2				6	2	2					7	3			
Mason.....	7	1					5	3						7	1			
McLean.....	14	2					13	3						15	1			
Menard.....	1						1							1				
Montgomery.....	4	5	3	1			1	1	2	1	2	5	1	6	4	1	2	
Moultrie.....	5		1				3	2	1					4	2			
Peoria.....	10		1				10	1						11				

Chinch Bug Injury Reported by Townships, 1887—Continued.

COUNTIES.	To Small Grain.						To Corn.						To Grass.					
	None.	Little.	Considerable.	Great.	Very great.	Complete.	None.	Little.	Considerable.	Great.	Very great.	Complete.	None.	Little.	Considerable.	Great.	Very great.	Complete.
<i>MIDDLE—Continued.</i>																		
Piatt.....	2						2						2					
Sangamon.....	9	3					9	1	3				10	3				
Shelby.....	2	5	2				1	3	1	1	2		8	1				
Stark.....	2	3	1				4	1	1				4	2				
Tazewell.....	4	4					5	3					7	1				
Woodford.....	6	5					9	1	1				10					
Total.....	120	39	12	7	2		111	31	5	11	4	6	11	1	146	28	2	4
<i>EASTERN.</i>																		
Champaign.....	16	1					15	2					17	4				
Clark.....	2	3	1	3	1		1		4	1	3		2	2	4			
Coles.....	5	2					1	4	1	1			6	1				
Cumberland.....	1		1	2	1		1		1	1	2		2	2	1			
Douglas.....	7	1					8						6	1		1		
Edgar.....	8	1					7		2				7	1	1			
Ford.....	7		1				7		1				7		1			
Iroquois.....	16	3					18	1					18	1				
Kankakee.....	6	1					6	1					6	1				
Vermilion.....	4	3					5	2					7					
Total.....	72	15	3	5	1	1	69	10	2	9	2	3	2	80	9	7	1	
<i>SOUTHERN.</i>																		
Alexander.....																		
Bond.....	1		3		1	1				1		4	1	2		3		
Clay.....			2	3	2	1	2				5	5	1	3	2	3		
Clinton.....			1	4	1	3	1	1			6	3		1	2	3	1	2
Crawford.....	1	1	2	1					2		1	1	1		3	1	1	
Effingham.....	2	2	3		3	1		1		2		1	5	2	1	4	2	
Edwards.....			1									1						
Fayette.....	1		2	4	1	1				2		4	3		3	4	2	
Franklin.....			4		1	2			1	1	1	4			5	2		
Gallatin.....																		
Hamilton.....			3		2	1					2	3	1		2	3		1
Hardin.....																		
Jackson.....	1	2	2	2	1					2	2	3	1		4	2	2	
Jasper.....			2		3						1	4			2	1	1	
Jefferson.....				1	4	2	3			3	1	5	1		1	2	6	1
Johnson.....	1		2		2						1				1	1		
Lawrence.....			2		2	1				2	1	1			2	1	1	
Madison.....	3	2	5	3	2	1			1	1	3	2	4	5	5	4	3	2
Marion.....	2	3	1	4				1			2	5	1		4	4	2	
Massac.....			7								7				7			
Monroe.....			2								1	1			2			
Perry.....					7						7				4		3	
Pope.....	1	1	4		1	2				2	5	2			1	1	4	3
Pulaski.....																		
Randolph.....			9	3	2		1				6	6	1	4	2	7	1	
Richland.....					2	1				1	1	1			1		2	
Saline.....																		
St. Clair.....	1	1	5	4	2						2	8	3		3	8	1	1
Union.....	1		1		2			1		1	1				1		3	1
Wabash.....		1			2					2		1			1			
Washington.....		1	4	2	3					1	4	5			2	3	3	2
Wayne.....	1		1	1	2	3	2	2		2	1	5			3	4	3	
White.....			1	3	1	1				2	4				2	3	1	
Williamson.....		1	2		1					1	3				1		1	
Total.....	1	12	19	76	28	55	15	6	4	3	1	7	33	45	90	29	35	68

NOTE.—The excess of numbers in this table in some sections, as compared with those in tables I. to VIII., on subsequent pages, is due to the fact that a part of the reports of damage received were not available in the later discussions, because corresponding reports of acreage were either wanting or imperfect.

INFLUENCE OF EXCESSIVE DROUTH.

The general conditions precedent to this chinch-bug uprising conform to the established principle that a succession of dry and warm summers has most to do with the origin of a chinch-bug outbreak; but it has not been heretofore noticed that drouth may become too severe for even this drouth-loving species. In some parts of Washington county the corn crop, and even the field grasses infested by the chinch bug, had been almost completely destroyed, in 1886, as early as the beginning of August, thousands of acres standing at the time as dry as in midwinter. This coming at the breeding season of the second generation, their multiplication was cut short, large numbers of the young perished in the fields, and the old, no longer able to find food there or to mature their eggs, were driven in immense numbers to the woods.

A visit made to this region at harvest time in 1887 showed that many fields at a little distance from the woods contained scarcely a chinch bug where there had been myriads the season before; and that fields in which these pests occurred in numbers sufficient to do serious mischief were almost invariably beside woodlands, or, if at a little distance, that only the borders nearest the woods were suffering. In the western part of the adjacent county of Clinton (visited at the same time), where the corn had been much less completely killed the year before, the chinch bugs were scattered everywhere, even miles from woods, and the early damage to small grain was much more severe.

EFFECT OF ABANDONING CORN AS A CROP.

These facts give us a hint of the results possible in a small grain country, if corn be abandoned for a time to reduce the food supply of the second generation. They amount, in fact, to a natural experiment on a very large scale, with this procedure. The results were certainly interesting; but the method has this drawback, that the meadows and pastures may be thus exposed to damage by desperate and starving hordes of chinch bugs searching the country for food. No serious injury was done, however, in this way to grass lands in the district indicated. While we shall see later that meadows may be used freely and extensively by the chinch bug as breeding grounds in spring, this is usually only where a fresh and succulent growth of young grass offers an extraordinary temptation. It would seem that the abandonment of corn wherever small grain is largely raised may be at least as effective a preventive measure as the abandonment of wheat where corn is the principal crop. Indeed, it may well be more so, since the attempt to reduce the first brood by limiting wheat culture must be made during the season of active growth for nearly every sort of vegetation, the chinch bugs having, therefore, at worst, an abundance of every kind of food save wheat; but the second brood

develops when most plants attacked by chinch bugs, excepting corn, are either dead or have ceased to grow rapidly, and the alternative food resources of the insects must be relatively few and slight.

SUCCESSIVE ABANDONMENT OF CORN AND WHEAT.

[The ideal procedure with wheat and corn, is doubtless the suppression of corn one year and of wheat the next, cutting down the second chinch-bug generation of one season and the first of the following. The effect of this rotation also was indicated by a spontaneous experiment made by nature in parts of Marion and Clinton counties in 1887 and 1888. Here the severe drouth of 1887 cut short the corn, in some neighborhoods early destroying it, so that not a stalk in acres ever formed an ear; and the wheat sown the following autumn was so badly winter-killed that practically all was plowed up in spring, the ground being replanted to other crops. As if in consequence of these occurrences, the chinch bugs in this region in the spring of 1888 were much fewer than in 1887, not more than one fourth as numerous according to my own judgment, local observers putting the difference at about one half.

SECONDARY EFFECTS OF THE ABANDONMENT OF WHEAT.

Suspension or abandonment of wheat culture has been for a hundred years the favorite method of evading the ravages of the chinch bug; but, so far as I know, this measure has heretofore been taken only when the insect hordes were about to disappear under the action of other and more general causes, and the real effect of this variation in farm management has consequently not been clearly demonstrated. Other unplanned experiments of the kind which I have found so instructive lately, have thrown much light on this subject also.

About Edgewood, in Effingham county, where scarcely any wheat was raised in 1887, it was clear to a demonstration, June 21, that the chinch bugs had lived and bred since early spring in timothy meadows, many of which were already hopelessly ruined for the year; and from these meadows the bugs were then making their way to oats and corn. Oats fields had also become infested by flying adults in spring, and young and old were everywhere distributed, many acres of oats being dead and dried up.

In some parts of Clay county—notably about Flora—the amount of land in wheat had been gradually diminished from year to year, until, in the spring of 1888, I could find but two small fields in a considerable district. The insect wave had here, however, but just reached its height, and to the general alarm, not only were the bugs more numerous than ever before, but they were widely and generally dispersed through oats and young

timothy meadows and even in blue grass pastures, breeding as rapidly there, to all appearance, as if these fields had been in wheat. The oats especially were suffering everywhere, bugs of all ages being equally dispersed throughout the fields*; and, later, corn fields were invaded in the usual way, first from the edges, and then by a general flight. In short, it was difficult to believe, after a careful examination of this neighborhood, that the chinch bugs would have been any more abundant if every other field had been in wheat; while it seemed probable that if a moderate amount of wheat had been sown, this would have received the weight of the attack and the other crops would have been correspondingly relieved.†

RELATIONS OF THE AREA OF WHEAT AND OTHER CROPS TO CHINCH-BUG INJURY.

The fact (now to be clearly seen in Illinois) that chinch bugs will breed in winter wheat as well as in the spring varieties, and, under certain circumstances, in oats and timothy scarcely, if at all, less freely than in wheat, tends greatly to unsettle the ideas of the entomologist and to confuse the practice of the farmer, especially as we lack authentic detailed evidence on the relation of wheat and other crops to chinch-bug increase, drawn from a territory large enough to warrant positive generalization. I have consequently thought it highly important that an extended and thorough-going study should be made of the relations of the culture of wheat (and indeed of oats, corn, and grass likewise) to chinch-bug injury to the various crops.

Conditions in Illinois during 1887 were as favorable to the investigation of this subject as it would have been possible to arrange, since we had coincident every variation in chinch-bug damage, from none whatever to the complete destruction of every crop liable to attack, and also every variation in wheat culture,

*The marked preference for wheat where both wheat and oats are accessible to the chinch bug was very clearly demonstrated by an observation which I made in Washington county in 1886. In a field sown partly to each crop, with no fence between, chinch bugs were thickly clustered on the stems of wheat, especially on the nodes, up to the very boundary line, but not one could be found on the other grain. Even where the two were intermingled, the stalks of wheat among the oats had been carefully sought out, while the oats plants among the wheat were as generally avoided.

†Of especial interest in this connection is the following letter written May 14, 1887, by Hon. J. W. Robison, Towanda, Kansas, a former resident and large farmer of Illinois and an ex-senator of this State:

"The old chinch bugs,—those of last year's crop that have wintered over,—are now extremely numerous and destructive here; as numerous as I ever saw them in August and September in the mature form. They have already entirely destroyed the wheat on thin soil and half of that on our best lands. They have also destroyed at least half the oats crop, and, strange as it may appear, have killed a few patches of corn and are distributed over all our corn, from a few to fifty on a hill, the corn being from one inch to six inches in height. They are laying a very large crop of eggs on all these plants, but none have yet hatched. Our wheat is just heading out, and some heads are in blossom. This is the first time I have known old, last year's bugs to lay very many eggs on young corn. Timothy and orchard grass are very dry and small, but not harmed by the bugs."

from townships in Central and Northern Illinois in which not an acre of wheat was reported, to others—mostly in the southern part of the State—where the wheat area ranged from 10,000 to 13,000 acres per township.*

Further, where damage had been done, it was in some cases barely perceptible for the first time in many years, and in others had been repeated with extreme severity for several successive seasons. This made easily possible elaborate comparison in all parts of the State between the wheat acreage and the amount of chinch-bug damage done to the principal crops. If the latter was found to vary generally with the former, the area in wheat increasing or diminishing where injury to corn, grass, etc., was greater or less, the presumption would be very strong that there was some connection of cause and effect between these two sets of data. I consequently undertook to collect, classify, and discuss the facts obtainable in this State bearing on this important matter,—a labor which has absorbed much of my own time and the greater part of that of two assistants during some months of the summer and fall. The scope of my inquiry was finally widened so as to include an examination of the relations of chinch-bug injury to corn and grass, as well as to wheat and the other small grains, with a view to showing the kind of rotation or cropping prevalent in the worst infested districts as compared with those nearly or quite free from damage.

COLLECTION OF DATA.

For the facts of both orders, I had recourse to township assessors throughout the State. Those concerning acreage in wheat and other crops were compiled from the Assessors' Reports for the years 1886 and 1887 on file at the State Capitol; and those concerning insect injury to small grain, corn, and grass, were secured by correspondence with the officers who made the assessment for 1887. In order that the last mentioned facts might be uniformly stated in a way to make them available for tabulation, the following slip and postal-card circular were sent to every assessor in the State. The terms selected for the card of inquiry made a series as uniformly graded as was convenient, of expressions to which every one was accustomed and to which all would attach a practically identical meaning.

OFFICE STATE ENTOMOLOGIST,
CHAMPAIGN, ILL., March 5, 1888.

DEAR SIR: As an important item in an investigation of the relations of wheat culture to the chinch bug, which I have undertaken, I need an estimate, by assessors, of the amount of chinch-bug injury in their respective towns for the season of 1887. Will you be kind enough to note upon the card enclosed your judgment of this matter, returning to me without unnecessary delay?

Very Respectfully,

S. A. FORBES,
State Entomologist.

*This last in Washington county.

ESTIMATE OF LOSS BY CHINCH BUGS,

Summer of 1887.

[Please indicate by underlining the proper words in columns below.]

TO SMALL GRAIN.	TO GRASS.	TO CORN.
1. None	1. None	1. None.
2. Little	2. Little	2. Little.
3. Moderate	3. Moderate	3. Moderate.
4. Considerable	4. Considerable	4. Considerable.
5. Great	5. Great	5. Great.
6. Very Great	6. Very Great	6. Very Great.
7. Nearly Complete	7. Nearly Complete	7. Nearly Complete.
8. Complete	8. Complete	8. Complete.

Was injury greater in neighborhoods where wheat or barley was grown than elsewhere?

Signature:.....

County:.....

Town:.....

Eight hundred and sixty-two assessors reported by the return of these cards marked so as to indicate their judgment of the amount of chinch-bug injury in their respective townships.

STUDY OF DATA.

In studying the data thus collected, the State was first divided into six sections; each section to be studied separately from all points of view. Later, the two northern sections were thrown together, and also the three middle ones, the data being thus summarized separately for the three principal regions, Northern, Central and Southern Illinois; and finally the State was studied as a whole, without reference to geographical divisions. For each of these areas the postal card township reports were distributed in groups according to the amount of damage done to each of the principal farm crops,—first to small grain, next to grass, and finally to corn. For example, all the cards showing no injury to corn were brought together in one group, all those showing a “little” injury to the crop in another, all reporting “moderate” damage in a third, and so on, until all the cards received were divided into eight lots, corresponding to the eight degrees of injury to corn distinguished. Then, lists being made of the townships belonging to each group as thus classified, the acreage in wheat for each township was taken from the tables of acreage already mentioned, and an average struck for each group corresponding to each grade of chinch-bug injury. These averages being set down in the progressive order of increasing loss by chinch bugs from “none” to complete devastation, it was at once apparent whether any connection between the wheat area and the insect damage was to be made out, the list of numbers showing the wheat acreage being, on the whole, an increasing series if such connection existed, and otherwise not.

Tables of this description were made for each year (1886 and 1887) and for each crop in each of the areas above mentioned, the whole being finally summarized and concluded by a general table setting forth the facts for the whole State, and for all the crops taken together.

GENERAL REMARKS UPON THE TABLES.

Before entering upon a detailed examination of these tables, a few critical and explanatory remarks may well be made.

In the first place, as the data here set forth relate to only one of a considerable number of varying conditions which must affect the multiplication of the chinch bug and its consequent damage to crops, it is not to be expected that any correspondence apparent between wheat culture and chinch-bug injury will be always clear and uniform. As it is impossible that conditions of weather, general average of soil, methods of cropping and farm management, and the like, should be the same for all the groups of townships, these and various other influences must have had their various effects on the number and condition of the chinch bugs in each case, so that a certain amount of variation, upward and downward, will appear in the various series, really due to these concealed but ever present differences of circumstance.

Where the wheat acreage is very small and the chinch-bug damage light, as in Northern Illinois, these miscellaneous and accidental variations may completely conceal the slight variations to be attributed to the insignificant differences in the amount of wheat.

Secondly, although the township assessors are doubtless, on the whole, the class of men most likely to judge intelligently and accurately concerning the damage done in their townships, this is really a difficult matter to estimate, particularly as my questions were not put to them until after they had made their annual round. The judgment of different men must consequently sometimes have differed widely with respect to like conditions and grades of injury. The meaning attached to the terms used in expressing their estimates of injury must also doubtless have varied considerably,—although less, as I judged, than if I had asked men not accustomed to think in ratios to give their opinions in the form of percentages of injury. Other variations without significance must have resulted from the fact that in all this investigation the township has necessarily been taken as an unvarying agricultural unit,—of uniform size, and with always the same ratios of cultivated and uncultivated lands.

The more or less serious errors thus arising are all, however, of a sort to decrease rapidly with the accumulation of instances, being most apparent in the tables of the smaller sections and chiefly obliterated in the final tables for the larger sections and for the entire State. In the concluding diagram it seems to me

that this process of mutual cancellation must have reduced them practically to nothing, with the exception of certain geographical differences to be noticed when that plate is discussed.

Because of the unavoidable variations thus arising, I have made no use, in my discussions, of averages drawn from groups of less than five towns each,—a limit which excludes the more violent, accidental, and miscellaneous fluctuations, but which still leaves some of considerable importance.

Further, it is to be noted that the terms used in the township reports of injury are not uniformly graded, the gradations being much closer for the lower degrees of damage than for the higher. The destruction of half a crop would doubtless be called a "great" loss, if not a "very great" one, so that the first fifty per cent. of injury is divided by my scale of expressions into four or five degrees, and the last fifty per cent. into only two or three.

I have also to notice that it was usually quite impossible to distinguish accurately the amount of damage done by chinch bugs from that due to drouth, and it is probable that many of the severest cases of damage were really due to drouth and insects combined.

Finally, I beg to remind the reader that the facts here presented are derived from more than eight hundred men widely scattered throughout the State, each peculiarly competent to observe and report the data for his own district; and that the evidence thus accumulated far outweighs that on which any one man or any entire neighborhood can rest an opinion,—amounts to many times more, indeed, than all that has been previously reported on this topic. I believe that I am asking no more than is deserved by the tedious labor whose outcome is here presented, when I claim that this mass of testimony should be considered as decisive wherever its indications are positive and manifest.

INJURY TO CORN AS COMPARED WITH ACREAGE IN WHEAT AND OTHER GRAINS.

TABLE I.

Southern Illinois, 191 Towns. Injury to Corn, 1887, compared with Crop Areas for the Same Year.

Degree of Injury.	No. of Tps.	Wheat.	Barley.	Rye.	Oats.	Corn.	Grass.
None.....	4	1,784	1	5	1,093	1,811	2,462
Little.....	2	3,974	4	15	1,872	2,876	1,640
Moderate.....	1	1,600	.....	.....	245	800	210
Considerable.....	7	1,905	.....	14	1,114	2,419	2,121
Great.....	24	3,289	1	18	1,521	3,057	2,805
Very great.....	40	2,278	.....	16	1,375	2,391	2,616
Nearly complete.....	85	2,945	8	23	2,104	2,859	3,152
Complete.....	28	4,266	1	17	2,671	3,157	2,975

I have selected, first, for examination the relation between injury by chinch bugs to corn in 1887, and acreage in wheat and other grains for the same year. As the chinch bugs bred in wheat in spring resort finally to corn, and rear there almost exclusively the second brood of the season, we should expect to find any increase in chinch bugs due to a large wheat acreage, expressed in a larger degree of damage to corn in the same territory. Examining first the table for Southern Illinois and throwing out the first three groups of townships because too small to give an average of any value, we observe a slightly irregular but unmistakable increase in average wheat acreage as the chinch-bug injury to corn increases. Seven towns reporting the injury to corn as "considerable," have a wheat area of 1,905 acres each, while twenty-eight towns where the corn was totally destroyed averaged two and a fourth times as much—4,266 acres each. The intermediate numbers form an ascending series, except that the second one is unduly high, but still below the last. This plainly shows that in Southern Illinois, in 1887, the wheat area was much greater, on the whole, where the damage to corn by chinch bugs was the greater, and greatest of all where the destruction was complete.

Immediately, however, an interesting and important question arises. Is it not possible that in these towns less corn was raised where there was more wheat, the area in the two crops varying inversely, the great chinch-bug injury to corn apparent being then due to the smaller corn acreage, and the consequent closer concentration of insects in what corn there was?

The column headed "corn" in the same table gives the answer to this question, and from this we learn that the corn area did not decrease as the wheat area enlarged, but that, on the contrary, it actually increased (though irregularly) as the wheat did.* Certainly, therefore, the corn was not more injured only because there was less of it.

That the corn acreage should increase with chinch-bug injury to the crop is a surprising fact, and suggests a glance at the columns for oats and grass (barley and rye being insignificant crops in Southern Illinois), and here we learn that the area in these two great staples also was the greater where chinch bugs were the more abundant,—the increase in the numbers for these crops being an almost continuous one from 1,114 to 2,671 for oats and from 2,121 to 2,975 for grass. We reach, consequently, the interesting and unexpected generalization that where the destruction of corn by chinch bugs in the southern part of the State was greater, the area was greater in wheat, oats, corn, and grass,—that is in the staple farm products of the region. This is little more than

*The first two numbers in this series of five amount to 5,476 and the last to 6,016.

saying that the greater was the damage, the larger was the area in crops of any and all kinds capable of furnishing food to chinch bugs*.

This conclusion clearly compels at once a reconsideration of the effect of wheat alone,—a re-examination of the table so made as to ascertain whether the wheat area increases faster with increased injury than does the area in the other crops reported. On this point the indications of the table are not quite clear, but are nevertheless interesting and suggestive. The increase in wheat corresponding to the five available numbers of the table we find to amount to an average of 31 per cent. for each step of the gradation; while that of corn amounts to only 8 per cent.; that of grass to 10 per cent.; and that of oats to 33 per cent.; in other words, while wheat and oats have increased in about the same ratio with increase of injury by chinch bugs, and bear, so far as this table is concerned, the same relation to such increase, the corresponding increase of corn has amounted to only about one fourth that of the wheat, and the grass increase to about one third. From this we are certainly justified in concluding, provisionally, that, even under the extreme conditions prevailing in Southern Illinois last year, the acreage of wheat has more to do with the increase of chinch-bug injury to *corn* than the area of any other crop, except, perhaps, oats; but as the latter crop, and also corn and grass, seem also to favor insect increase, we find little encouragement for the supposition that under such circumstances an abandonment of wheat alone will serve to control injury by the chinch bug, or seriously to check its increase.

TABLE II.

Central Illinois, 397 Towns. Injury to Corn, 1887, compared with Crop Areas for the Same Year.

Degree of Injury.	No. of Tps.	Wheat.	Barley.	Rye.	Oats.	Corn.	Grass.
None.....	244	1,311	1	98	2,754	5,765	5,992
Little.....	73	2,080	1	44	2,281	5,045	5,439
Moderate.....	14	2,368	5	31	1,711	4,488	4,880
Considerable.....	33	2,582	.....	16	1,172	3,275	4,338
Great.....	8	2,641	.....	23	1,502	3,003	5,331
Very great.....	11	2,949	.....	45	2,134	4,514	5,154
Nearly complete.....	13	3,189	.....	27	2,254	4,428	6,017
Complete.....	1	6,113	.....	317	4,257	7,251	11,616

Passing now to Table II., for 397 towns of Central Illinois where all the grades of injury to corn except the highest are represented by groups of townships sufficiently large to be available

*As it here seemed possible that the larger area under cultivation was a consequence of the greater and long-continued chinch bug injury with which I found it associated, and not in any sense a cause,—due, in fact, to the clearing up of the richer bottom lands in Southern Illinois, where the partially exhausted prairie lands had repeatedly failed to yield a profitable crop,—I thoroughly overhauled my data with this point in mind, but without finding any ground for such a conclusion. The area under cultivation in the principal crops was greater in 1887 than in 1886, but the increase was not more marked in regions badly infested than in those where the damage was less.

for discussion, we observe at once that the figures for wheat increase regularly from 1,311 acres per township, where the injury was none, to 3,189 acres, where the loss was nearly complete. An inspection of the columns for the other crops shows us that here the grass areas remain about the same, neither rising nor falling, if we take the list together; but that the figures for corn and oats clearly show a tendency the reverse of that observed in Southern Illinois; for while the successive numbers run somewhat irregularly, the whole series is clearly a descending one. Certainly, therefore, we must conclude that in this great territory increased injury to corn goes along with an increased acreage in wheat, as in Southern Illinois; but as this is also attended by a decreased acreage of corn and oats, it remains for us to determine whether the greater damage to corn may not all be connected with this latter fact,—may not be due simply to a more concentrated attack in the smaller corn area. A simple calculation demonstrates, however, that the average increase in the series of figures for wheat, (24 per cent.) is nearly five times as great as the average inverse ratio in the figures for corn (5 per cent.) and six times as great as for oats (4 per cent.). In other words, as the wheat area increases many times faster than the corn area decreases, the increased wheat area must be held to have much more to do with the greater chinch-bug injury than does the decreased corn area.

From this table we seem to learn that *in the beginning* of a chinch-bug outbreak the area in wheat has much more to do with the continuance and increase of injury than that in any other crop; that the acreage of oats, corn, and grass has then, in fact, no apparent influence, where wheat is also raised.

The separate tables for the three subdivisions of Central Illinois simply show in each the same state of facts apparent in the more general exhibit, and are consequently not here reproduced.

TABLE III.

Northern Illinois, 224 Towns. Injury to Corn, 1887, compared with Crop Areas for the Same Year.

Degree of Injury.	No. of Tps.	Wheat.	Barley.	Rye.	Oats.	Corn.	Grass.
None	147	343	152	376	3,119	4,628	8,173
Little	48	338	165	427	3,199	4,734	7,976
Moderate	10	324	136	340	2,952	3,786	7,300
Considerable.....	16	335	165	251	3,169	4,569	6,957
Great	2	431	9	368	3,115	5,065	9,632
Very great.....	1	213	10	14	445	1,090	2,526

As is sufficiently evident from Table III., reports from Northern Illinois can scarcely be used in this branch of our discussion, both chinch-bug injury to corn, and the area in wheat being of so little importance that whatever slight effect one may have had upon the other, is completely lost to view in the presence of other causes of variation. Only the four minor grades of the scale of

injury are available, since but three towns reported damage to corn as more than considerable. On the other hand, the wheat acreage, including both spring and winter varieties, does not reach 350 acres per township in any of the groups, nor fall as low as 320. Evidence as to the connection between wheat culture and chinch-bug injury can be expected here only as a result of close observation, in small neighborhoods; and such evidence for Northern Illinois will be presented under another head.

Here, also, the tables for subdivisions (northwestern and north-eastern Illinois) agree in general with those from the larger table including both.*

TABLE IV.

The Whole State, 812 Towns. Injury to Corn, 1887, compared with Crop Areas for the Same Year.

Degree of Injury.	No. of Tps.	Wheat.	Barley.	Rye.	Oats.	Corn.	Grass.
None	395	956	57	200	2,873	5,302	6,768
Little	123	1,431	65	193	2,633	4,888	6,367
Moderate	25	1,520	57	153	2,149	4,060	5,685
Considerable	56	1,856	47	83	1,735	3,533	4,809
Great	34	2,968	2	40	1,610	3,163	3,800
Very great	52	2,386	1	22	1,51	2,814	3,151
Nearly complete	98	2,977	3	23	2,124	3,067	3,532
Complete	29	4,329	1	28	2,726	3,298	3,273

Combining now the facts derived from the whole State in one general table setting forth the relations of the acreage of the principal farm crops to chinch-bug injury to corn for the year 1887, we notice first the greater value to be assigned to the averages presented by this table, and the greater weight to be attached to its results, due to the greater area covered by it, and the more numerous observations which it summarizes. Representing reports from 812 towns, and no group including less than 25, we must consider this table as of much higher authority than the preceding ones.

Its showings, however, are not essentially different from those already set forth, amounting, in fact, to a combination of those from the first two of our series. The wheat numbers increase, with only one unimportant break, from 956 acres per township where the corn was not injured to 4,329 where it was completely destroyed, the successive steps of increase thus averaging about fifty per cent. of the lowest number. The column of figures for each of the other crops presents us, on the other hand, with a mixed series, descending uniformly to the grade of injury marked as "very great," and then ascending by two steps to the end,—clearly a repetition on a larger scale of the facts exhibited by the separate tables for Central and Southern Illinois. The southern

*The only exception to this statement is shown by the spring-wheat series for Northwestern Illinois. Taking that alone, we have a noticeable increase from 326 acres per township to 411, corresponding to a damage to corn ranging from "none" to "considerable."

part of the State, where the wheat acreage was large and the injury very severe, dominates the lower part of the table, the groups of townships representing the three higher grades of injury, being mostly in that section;* while the upper part of this general table is little but a copy of the corresponding part of that for Central Illinois, the averages drawn from the relatively large wheat acreage there being little affected by the very small wheat acreage of the northern district. Table IV. is, therefore, less an average of the others than a summary recapitulation of their teaching. The descending series presented by the six upper figures of the columns for rye, oats, corn, and grass remind us that a diminishing area of these crops goes with the increasing wheat areas of the first column, but that the decrease of the former is insignificant in comparison with the rate of increase of the latter;† while the regular rise in the lower numbers in each column simply expresses anew the fact that where the chinch bug has been long enough abundant to practically occupy the country, it will multiply according to the area in any and all crops capable of affording it food. In other words, these tables show us that corn suffered worst, as a rule, in 1887, in those counties and townships where wheat was most abundant, and that a regular gradation of injury to corn by the chinch bug may be made out corresponding to the gradation in the wheat acreage; and, further, we learn that where the chinch bug became very numerous, the other great grass crops,—that is, the other small grains, corn, and the grass forage plants,—began to suffer heavily, to breed the first generation of the bugs, and so to encourage their increase and the consequent damage to corn—oats being the first to take this turn, and corn and grass the next.

From these tables we may draw, then, this *provisional practical conclusion*, to be tested by the remaining tables of the series, *that a limitation or abandonment of wheat culture may be expected to serve as a preventive measure at the beginning of a chinch-bug outbreak but that it cannot be depended on as a remedy when such an outbreak is fully developed.*

INJURY TO GRASS AS COMPARED WITH AREAS IN WHEAT AND OTHER CROPS.

Meadows and pastures are often invaded by chinch bugs escaping from ripening grain; and where the drouth is so severe as to destroy the corn in summer, the second generation may be bred to some extent in grass. It also occasionally happens that if nothing else offers as food for the hibernating generation, young meadows tempt them in spring to settle and lay their eggs and there rear their young as in fields of wheat. A study of the relation of wheat culture to injury to grass will therefore have its special

*It will be seen (Table I.) that 153 of the 179 towns reporting an injury to corn higher than "great" are in Southern Illinois, and only 26 from Central and Northern Illinois (Tables II. and III.)

†This relation of the crop areas in Central Illinois is doubtless due to the fact that much of the wheat of the region is raised in districts not as well adapted to any other crop,—the broken clay lands, originally wooded, along the streams.

interest, and may serve likewise as a partial check on conclusions drawn from the discussion of the injury to corn. The grass injury was, however, relatively so light that only the five lesser grades can be used, even for Southern Illinois.

TABLE V.

Southern Illinois, 191 Towns. Injury to Grass, 1887, compared with Crop Areas for the Same Year.

Degree of Injury.	No. of Tps.	Wheat.	Barley.	Rye.	Oats.	Corn.	Grass.
None.....	27	3,693	4	7	1,601	2,965	3,308
Little.....	63	3,201	2	18	1,776	2,689	2,813
Moderate.....	45	2,450	1	19	1,804	2,536	2,504
Considerable.....	46	2,681	1	22	2,185	2,870	3,110
Great.....	5	3,742	.....	35	2,265	3,091	2,477
Very great.....	3	4,369	.....	87	2,986	4,112	3,405
Nearly complete.....	2	2,688	.....	6	2,084	3,913	3,225

In that region there was no recognizable increase of the wheat area with the increase of injury to meadows and pastures, but there *was* a distinct enlargement of the area of *oats*, from 1,601 acres where the grass injury was "nothing" to 2,265 where it was "very great." Corn, on the other hand, neither rises nor falls, but the grass itself falls from 3,308 to 2,477 acres per township—decreasing, that is, in about the same ratio as that in which the oats increase. If we may draw any inference from these figures, it must be that when chinch bugs are excessively numerous, grass lands adjoining oats are especially liable to injury, and that this damage is consequently greatest where oats fields are most common. It is entirely possible that, in this increasing oats acreage, we see reflected the facts observed in the field with respect to the spring breeding of chinch bugs in oats in this worst infested region,—this crop taking the place of wheat, in part, as food for the first generation. It is also possible that the amount of wheat grown has its influence, but that this is masked by the greater effect of differences in the other crop.

TABLE VI.

Central Illinois, 397 Towns. Injury to Grass, 1887, compared with Crop Areas for the Same Year.

Degree of Injury.	No. of Tps.	Wheat.	Barley.	Rye.	Oats.	Corn.	Grass.
None.....	319	1,620	1	83	2,575	5,507	5,825
Little.....	58	2,113	2	42	1,951	4,139	4,960
Moderate.....	12	1,960	.....	30	1,680	3,792	5,199
Considerable.....	8	3,523	.....	35	1,924	5,270	6,432

In the central part of the State where we are limited to degrees of injury not higher than "considerable," and where, it is
S. E.—2a

always to be remembered, we had the local beginnings of mischief merely, we find the connection between the grass injury and the wheat area clearly indicated, the acreage in wheat more than doubling—if we may use our highest group of only eight townships—between the first and last numbers of the series of Table VI.

It may also be noticed that the numbers of the oats column now tend to decrease, while those of grass and corn neither rise nor fall.

TABLE VII.

Northern Illinois, 224 Towns. Injury to Grass, 1887, compared with Crop Areas for the Same Year.

Degree of Injury.	No. of Tps.	Wheat.	Barley.	Rye.	Oats.	Corn.	Grass.
None.....	193	338	147	384	3,182	4,726	9,196
Little.....	19	358	225	325	2,961	3,976	6,527
Moderate.....	8	379	88	232	2,477	3,366	7,438
Considerable.....	3	198	288	393	1,767	3,129	5,460
Great.....	1	548	.....	412	3,351	5,719	9,346

Next, in Northern Illinois we find an appreciable, though slight, increase in wheat, and a decided decrease in oats and corn accompanying the increase in injury to grass from “none” to “moderate,”—beyond which grade we cannot go.

TABLE VIII.

The Whole State, 812 Towns. Injury to Grass, 1887, compared with Crop Areas for the Same Year.

Degree of Injury.	No. of Tps.	Wheat.	Barley.	Rye.	Oats.	Corn.	Grass.
None.....	539	1,265	54	187	2,744	5,100	6,548
Little.....	140	2,364	32	70	2,009	3,464	4,207
Moderate.....	65	2,105	11	47	1,864	2,870	3,609
Considerable.....	57	2,628	16	43	2,127	3,220	3,700
Great.....	6	3,200	.....	98	2,446	3,529	3,621
Very great.....	3	4,369	.....	87	2,986	4,112	3,404
Nearly complete.....	2	2,688	.....	6	2,085	3,912	3,225

Finally, the figures for the State at large bring out beyond dispute the relation of wheat culture to the injury to grass, the area in that grain running upward from 1,265 acres per township to 3,209 as the damage to grass passes from “none” to “very great.” There is little else of interest to be drawn from this table except the fact that grass was least hurt where the largest amount of land was under cultivation, as shown by the average of 15,900 acres per town in the great farm staples where meadows and pastures were uninjured, as compared with 12,900 acres where the damage was considered “great.”

DAMAGE TO SMALL GRAIN AS COMPARED WITH THE AREA IN WHEAT AND OTHER CROPS.

Perhaps the most difficult, and certainly the most interesting, significant, and conclusive part of this discussion relates to the influence of wheat culture on damage to wheat itself and to oats by the first brood of the bugs, under the two widely contrasted sets of conditions found in Central and Southern Illinois respectively, in 1887. Certainly if it shall appear that the ratio of damage to these crops increased with increase in the areas of the crops themselves,—if, in other words, the first brood of the chinch-bug destroyed a larger percentage of these grains the larger was the surface covered by them,—we cannot possibly avoid the conclusion that wheat culture has a powerful effect on chinch-bug injury. If, further, we shall discover here the same contrast between Southern Illinois and the other parts of the State as has appeared in previous discussions, we shall be confirmed in the opinion that a measure like the reduction of wheat culture, which may promise the best results when early applied, may wholly lose its efficacy, and possibly even become a source of mischief, if postponed too long.

TABLE IX.

Central Illinois, 397 Towns. Injury to Small Grain, 1887, compared with Crop Areas for the Same Year.

Degree of Injury.	No. of Tps.	Wheat.	Barley.	Rye.	Oats.	Corn.	Grass.
None.....	271	1,559	1	89	2,581	5,579	5,897
Little.....	79	1,984	3	52	2,467	5,135	5,902
Moderate.....	28	2,436	.....	13	1,456	3,412	3,501
Considerable.....	15	2,321	1	41	1,828	3,551	5,486
Great.....	1	901	.....	12	931	1,532	2,285
Very Great.....	3	2,668	.....	47	2,251	5,461	4,275

Taking up first the table for Central Illinois, we see at once a decided ascent from 1,559 acres of wheat per township where wheat and oats were uninjured, to 2,321 acres where these grains were considerably damaged. That it is the increase in wheat that is to be connected with this greater loss, and not the decrease in acreage of oats (from 2,581 to 1,828) is shown by combining the wheat and oats areas for each grade of injury, giving 4,140 for the first term of the series and 4,149 for the last, the intermediate numbers being one above and one below the average. Otherwise stated, wheat and oats have suffered more severely, in Central Illinois, as the wheat area increased while the joint areas of both grains remained unchanged, whence we can only conclude consistently with the known preference of the chinch bug for wheat that it is the wheat increase which has caused the greater loss. We notice, further, that the acreage of grass shows neither marked increase nor decline; while that of corn falls off some 35 per cent,—the latter fact to be explained, as noticed elsewhere, by the relatively little attention given to corn in the broken regions especially adapted to wheat farming.

TABLE X.

Northern Illinois, 224 Towns. Injury to Small Grain, 1887 compared with Crop Areas for the Same Year.

Degree of Injury.	No. of Tps.	Wheat.	Barley.	Rye.	Oats.	Corn.	Grass.
None.....	120	334	138	403	3,055	4,528	8,384
Little.....	63	310	127	354	3,332	4,951	7,767
Moderate.....	18	362	354	408	3,508	4,412	7,995
Considerable.....	14	454	76	204	2,494	3,784	6,387
Great.....	6	461	397	384	2,968	5,164	6,706
Very great.....	2	236	49	299	1,932	4,238	9,617
Nearly complete.....	1	492	372	.....	2,520	2,582	2,856

A similar set of inferences are to be drawn (although less positively) from Table X., for the Northern part of the State, where the first five wheat numbers show a slight gradual increase, either taken alone or combined with those for barley.

TABLE XI.

Southern Illinois, 191 Towns. Injury to Small Grain, 1887, compared with Crop Areas for the Same Year.

Degree of Injury.	No. of Tps.	Wheat.	Barley.	Rye.	Oats.	Corn.	Grass.
None.....	1	1,439	6	4	1,875	2,623	3,407
Little.....	12	3,684	7	19	1,468	3,152	2,337
Moderate.....	16	3,646	1	7	1,474	2,415	2,242
Considerable.....	64	3,280	1	23	1,790	2,880	2,594
Great.....	27	3,201	2	15	1,616	2,569	3,208
Very great.....	50	2,714	2	23	2,168	2,720	3,075
Nearly complete.....	15	1,809	.....	14	2,221	2,956	3,175
Complete.....	6	1,110	.....	8	3,042	3,008	5,014

Passing, now, to the table for Southern Illinois, and omitting the single report of injury "none," we notice, first, a continuous *decline* in the numbers for wheat, from 3,684 acres to 1,110, and a continuous *increase* in those for oats, from 1,468 to 3,042, while grass runs irregularly upward from 2,337 acres to 5,014. Corn, on the other hand, varies without perceptible law. The combined acreage in wheat and oats falls away about twenty per cent.; but the total cultivated area is nearly uniform.

The meaning of these complications seems reasonably clear:—

1. In a country where the chinch bug has long prevailed and multiplied without check, it outgrows its dependence on any one crop, and with its vast numbers and momentum of increase is able to maintain itself and even to multiply where it would otherwise suffer suppression,—a conclusion which simply fortifies that already drawn from previous notes on the situation in this section.

2. We shall see later that a part (but not all) of the wheat decline is due to a partial abandonment of wheat in regions where the loss had been most severe in 1886,—a diminution in 1887 of the wheat area in those regions, as compared with that for 1886.

3. The facts presented in this table certainly support the idea—confirmed by many recent observations—that, where circumstances so favor the chinch bug that it passes beyond the stage of a general dependence on a large wheat area, it finds first in oats and later in grass, a sufficient support for its maintenance, and even for its more or less rapid increase. It is certainly a circumstance to challenge the attention of the student of this subject that an enlarging acreage of oats has invariably gone along with an increasing damage to every crop in Southern Illinois, while the wheat area has there *increased* with the corn injury, *stood still* with increasing injury to grass, and *diminished* with the growing damage to small grains themselves.

TABLE XII.

The Whole State, 812 Towns. Injury to Small Grain, 1887, compared with Crop Areas for the Same Year.

Degree of Injury.	No. of Tps.	Wheat.	Barley.	Rye.	Oats.	Corn.	Grass.
None	392	1,184	43	185	2,724	5,250	6,652
Little	154	1,432	54	173	2,745	4,905	6,387
Moderate	62	2,146	103	126	2,057	3,445	4,481
Considerable	93	2,700	12	54	1,902	3,125	3,631
Great	34	2,650	56	80	1,835	2,996	3,798
Very great	55	2,621	4	34	2,166	2,925	3,378
Nearly complete	16	1,727	23	13	2,240	2,932	3,155
Complete	6	1,110	.....	7	3,042	3,008	5,014

The table for the whole State amounts, as before, to but little more than a recapitulation of the exhibits for the several sections, the wheat areas rising with increased injury to wheat and oats where the central and northern figures preponderate, as in the lower grades of injury, and falling where the series comes under the controlling influence of the Southern Illinois reports.

COMPARISON OF THE CROPS FOR 1886 AND 1887.

Tables of the crops for 1886 were prepared of the same number and character as those for 1887, with a view to determining the drift of agricultural practice and its possible relation to the appearance and development of the chinch bug; but after a careful study of these tables in comparison with those for the following year, they do not seem sufficiently important to make their detailed treatment necessary.

The main features of difference were a great general increase in the wheat area for 1887 (twenty-five to thirty-five per cent.) in both Southern and Central Illinois, except in those districts where the chinch bug was most destructive. There, possibly because of a similar serious loss in 1886, the wheat acreage had been reduced by ratios varying from ten to twenty-five per cent.,—much more, however, in regions where *small grain* had been destroyed than where the *corn* was a total loss.

These facts show the indisposition of the average farmer to modify his practice until his losses are enormous and even ruinous ("complete" or "nearly complete" by our reports),—to take measures of prevention, in short, or to apply even remedial measures until his case is desperate, and probably beyond the reach of aid. They also show that he lessens his wheat acreage when that crop is heavily damaged by chinch bugs, because wheat becomes unprofitable, but will do so little, if at all, as a consequence of injury to corn. From the fact that the regions where the wheat area had been largely reduced in 1887 were still regions of greatest injury to small grain and even to corn, we may, perhaps, also infer that this diminution of the wheat area under the circumstances of extreme destruction there prevailing, had been without good effect.

A reduction—not abandonment—of the corn area has been sometimes recommended as a measure calculated to restrict the multiplication of the chinch bug by limiting the amount of food for the second generation;* but the results of the comparison of the corn areas of 1886 with the different grades of injury to small grain the following year, are unfavorable to this idea. In Southern Illinois, for example, the corn areas corresponding to the excessive grades of injury to small grain are respectively 2,572, 2,583, 2,767, 2,554, 2,881, 2,971 and 2,648—a variable but ascending series. In Central Illinois, figures corresponding to the first four grades of damage—the only one available—are 6,067, 5,332, 4,587 and 4,285—a rapidly declining series. The figures for Northern Illinois are without especial significance; and those for the whole State show a nearly uniform decline from 4,949 acres, where no injury was done to small grain, to 2,648, where the destruction was complete,—this series thus running in the direction opposite to that which the supposition above mentioned would require. We conclude, consequently, that any reduction of the corn acreage, to be an effective remedy for chinch-bug injuries, must, at any rate, go far below the area actually raised in any of the groups of townships represented on our tables.

INJURY TO ALL CROPS COMBINED, COMPARED WITH AVERAGE OF EACH.

To summarize my data more compactly I have attempted to unite the estimates of damage to all the crops injured by the chinch bugs so that the sum of the losses to agriculture due to this species may be treated as a single quantity. This I could only do by regarding small grain, grass, and corn as of equal importance, numbering the grades of injury recognized from 0 to 7, adding together for each township card the three numbers of the grades of injury reported for the three principal crops, and considering their sum as the total injury for the corresponding town-

ship. Thus, if the injury to small grain in a township was reported by its assessor as "considerable" (3), to grass as "none" (0), and to corn as "very great" (5), the total damage would stand at 8.

Arranging the card reports in the order of these numbers, so obtained, I had a series running from the lowest total injury to the highest, and could bring the different parts of this series into comparison with respect to the average acreage in each crop for 1887*,—drawn as before from the abstracts of assessors' reports to the State Department of Agriculture.

The series of numbers thus obtained is longer and more variable than those presented above, and the tendency of each column is not always easily detected by simple inspection; on which account I have prepared diagrams (pp. 26 to 31), presenting in graphic form the facts contained in the tables, and upon these diagrams the following discussions are based.

The grades of injury represented by the vertical columns of these diagrams range, as will be seen, from 0 to 20; and the numbers for average acreage per township at the left of the diagrams run from below upward. A line crossing a diagram from left to right thus indicates increasing grades of injury, while one passing from below upwards indicates an increase in average acreage per township; consequently, if a line passes obliquely upwards and to the right it shows that increasing injury by chinch bugs went with increased acreage; whereas if it passes obliquely downwards and to the right, it shows a decrease of acreage corresponding to increased injury.

In the following plates the broken lines have been so drawn as to represent the figures of the tables just mentioned, and lines of *average direction* have been added to show at a glance the general significance of the diagrams, and thus to facilitate comparison.

*These computations for 'all crops' were not made for 1886.

DIAGRAM I.

Southern Illinois, 191 Towns, 1887. Average Acreage in Wheat corresponding to Grades of Injury to all Crops.

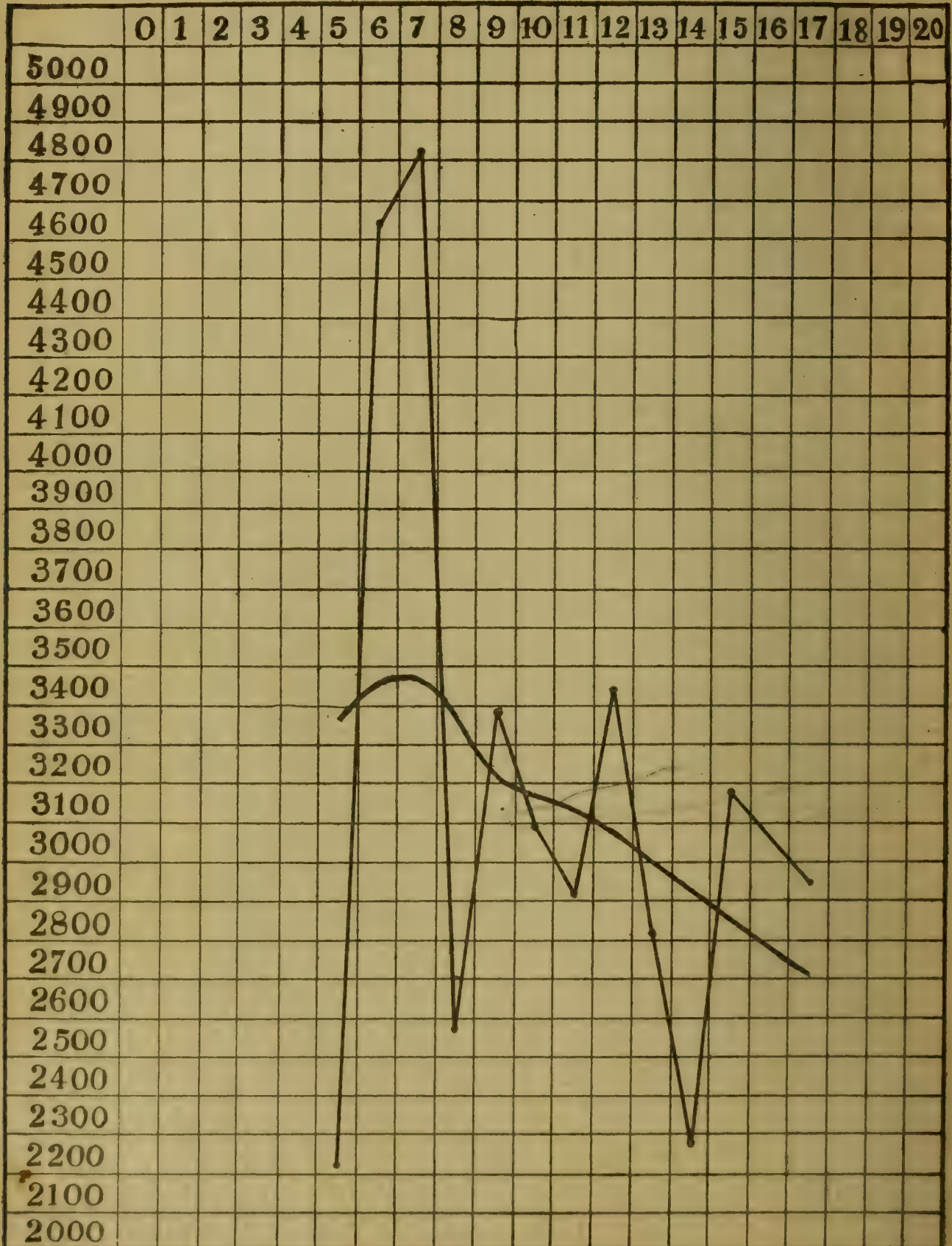


DIAGRAM II.

Southern Illinois, 191 Towns, 1887. Average Acreage in Grass (A) and Oats (B) corresponding to Grades of Injury to all Crops.

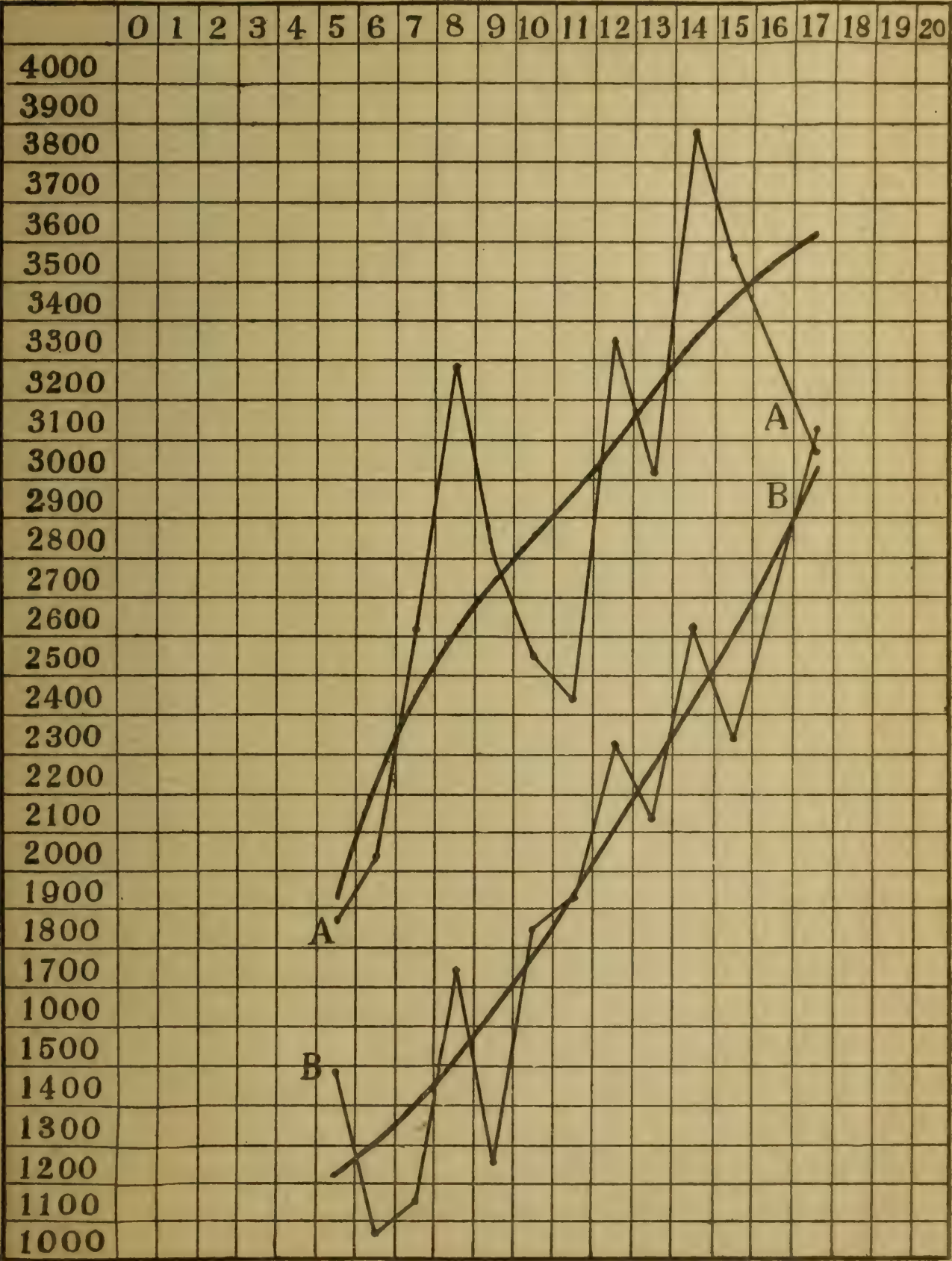


DIAGRAM III.

Central Illinois, 397 Towns, 1887. Average Acreage in Wheat (A) and Oats (B) corresponding to Grades of Injury to all Crops.

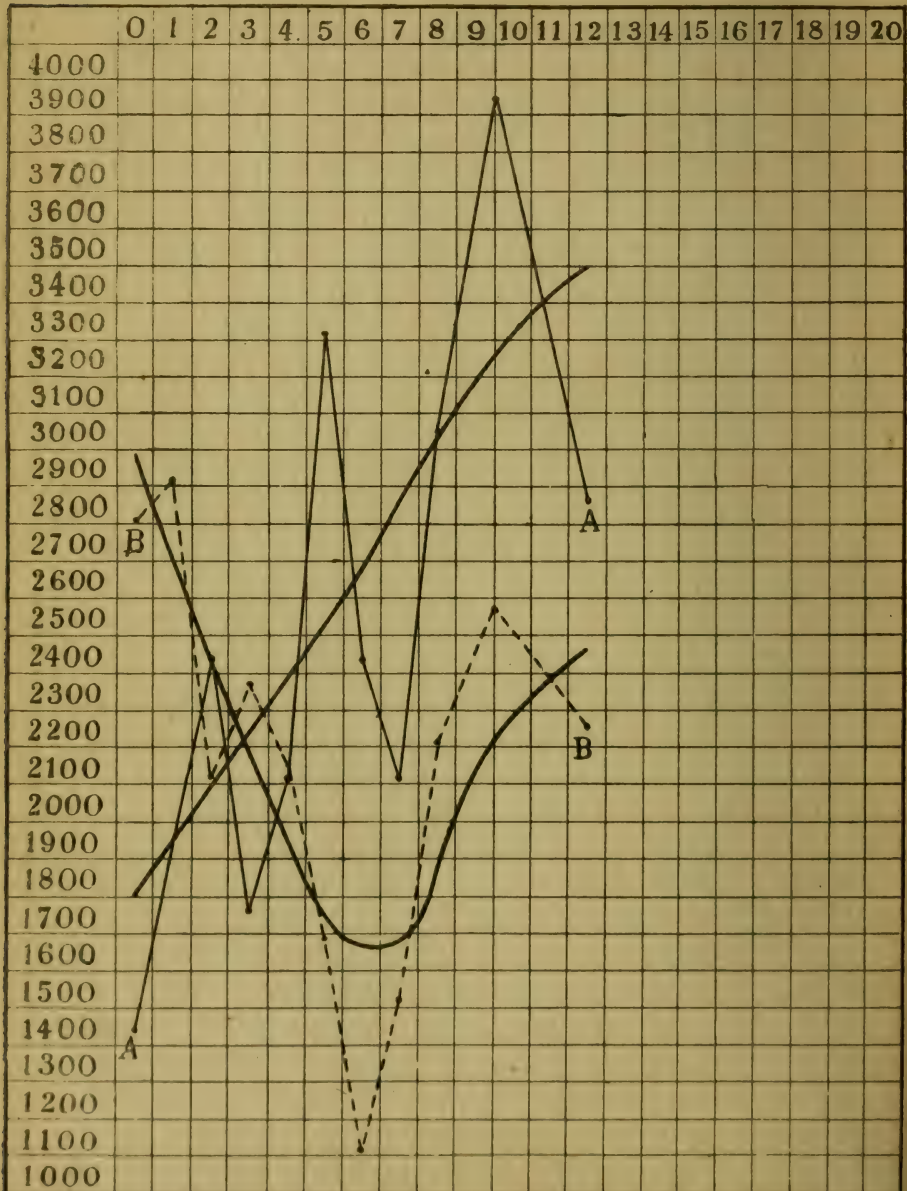


DIAGRAM IV.

Northern Illinois, 224 Towns, 1887. Average Acreage in Wheat corresponding to Grades of Injury to all Crops.

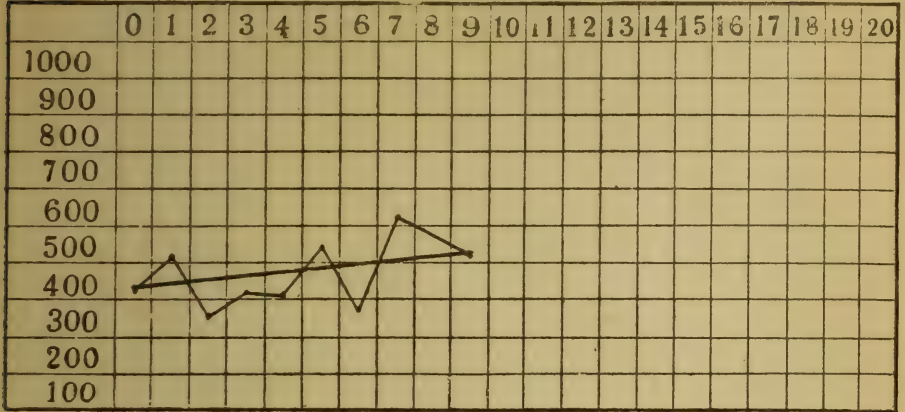


DIAGRAM V.

The Whole State, 812 Towns, 1887. Average Acreage in Oats (A) and Wheat (B) corresponding to Grades of Injury to all Crops.

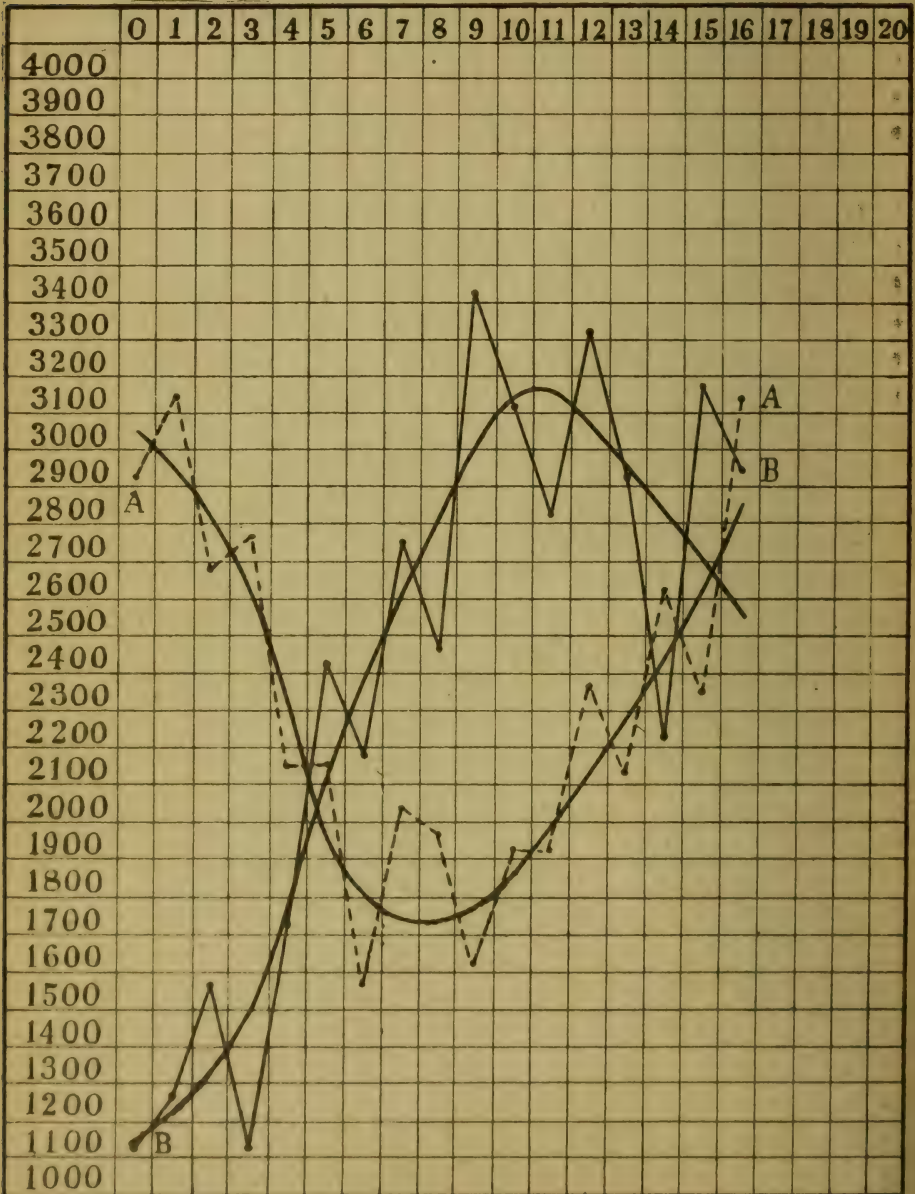
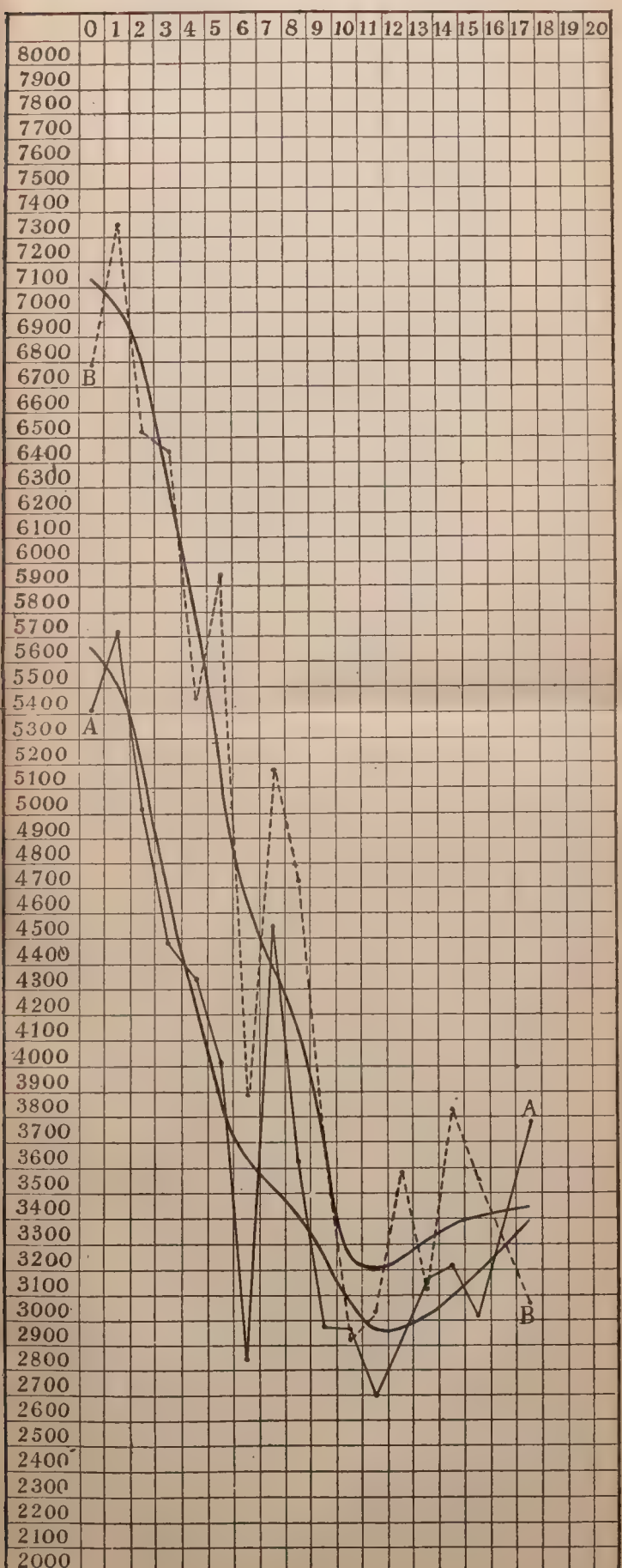


DIAGRAM VI.

The Whole State, 812 Towns, 1887. Average Acreage in Corn (A) and Grass (B) corresponding to Grades of Injury to all Crops by Chinch Bug.



DISCUSSION OF DIAGRAMS.

Diagram I. While the line representing the wheat area on Diagram I. is extremely irregular, the second and third points especially (derived respectively from only six and seven townships) being perhaps too high, its general tendency downward is unmistakable, as shown by the curved line of average direction. The declining slope of this line expresses the fact that in Southern Illinois the wheat area diminished, on the whole, with increasing chinch-bug injury to all the crops (including wheat itself), this diminution not affecting, however, the slighter grades of injury, where a rapid increase of the wheat area is apparent. Recalling the fact that the wheat acreage increased with the corn injury,* remained constant with increasing injury to grass,† and decreased with increasing injury to wheat and oats,‡ we see that this means that the diminishing acreage of the small-grain table overcomes, when combined with it, the increasing acreage of that for corn. The full significance of this exhibit can be best set forth in comparison with the data for oats, presented by line B on the next diagram.

Diagram II. This most interesting diagram shows with unmistakable clearness the relation of oats culture to chinch-bug injury in Southern Illinois last year. The rapid and fairly uniform ascent from about 1,200 acres per township for the lower grades of loss to 3,000 acres for the higher, represents probably the most important fact brought out by this whole study; viz., the relation of the oats area to chinch-bug increase where this has already reached an excessive pitch. The attentive reader will not have failed to notice, however, that the oats line begins with a downward slope, in opposition to the first part of that for wheat,—a hint at a point which we shall see fully brought out in the discussion of the situation in Central Illinois.

We observe next that the ascent of the line for oats (Diagram II.) is much more rapid than the descent of that for wheat (Diagram I.); that, in other words, the larger acreage of the former crop does not simply replace the diminished area of the latter, but does this and much more. If, as already intimated, this difference is taken as an indication of the extent to which the chinch bug bred in oats last year, it will be very difficult to show that this interpretation is erroneous.

The meaning of the lines for grass, (marked A on Diagram II.) is much the same as that of the lines for oats, just treated. An average upward slope of about the same pitch as the preceding, shows, as in the other case, in part the abandonment of wheat for grass in the worse infested neighborhoods, and in part the breeding of chinch bugs in meadows where the wheat area was very much reduced.

*Table I. p. 18. †Table V. p. 19. ‡Table XI. p. 22.

The corn acreage does not vary in Southern Illinois, as compared with our grades of total damage, in a way to make it worth discussing.

Diagram III. The diagram of total injury for Central Illinois (III.) conveys some extremely interesting and useful information, especially with respect to the relation of oats culture to the chinch bug. The average wheat acreage makes, on the whole, a rapid rise as the total loss by chinch bugs increases (line A); while the corresponding average for oats (line B) decreases at first,—that is where chinch bugs are less numerous,—but increases for the higher grades of loss,—where the bugs are more abundant. Otherwise stated, in those townships of Central Illinois where the chinch bug is injurious but has not yet become destructive, its numbers vary directly with the acreage of wheat and inversely with that of oats; but in those townships where it has become very abundant, it has already begun to breed in oats, and thenceforth its multiplication is stimulated by an increased oats acreage not less than by an increased area in wheat. We have here fully developed the fact barely noticeable in Diagrams I. and II., that where this insect injury is not yet great, it will, as a rule, be heaviest where there is most wheat and least oats, but that where it becomes severe, oats and wheat combine to increase its severity.

The corn and grass figures of the tables from which Diagram III. was drawn are too variable to have any significance, and hence **have not been diagramed.**

Diagram IV. The same may be said for that for Northern Illinois, only the column for wheat (Diagram IV.) having any particular meaning; and even here the ascending slope of the line for wheat is but slight. Still, it is to be noticed that the wheat area in the northern districts most injured by the chinch bug, was twenty-five per cent. greater, on an average, than in those not injured at all.

Diagrams V. and VI. Finally, for a concluding summary of all the diagrams and tables for 1887, we turn to diagrams V. and VI., showing the acreage in *each crop* for the whole State, corresponding to the various degrees of total chinch-bug damage. The larger number of observations here included obliterates many of the more prominent irregularities of the other diagrams, and brings out without complication the main features of a broad general conclusion. We see repeated here the marked contrast of conditions between Central and Southern Illinois (due, as already often explained, to the widely different stage of insect increase): the rapid rise of the wheat line (V., B.) and the slower falling away of the line for oats (V., A.) for the lower grades of injury; the rapid rise of the latter line and the slower falling of that for wheat for the higher grades,—the upward turn in the oats line being made a little in advance of the downward turn of that for wheat; the similar but less marked contrast between the lines for corn and grass (Dia-

gram VI.),—now first brought out on this general diagram; and the more rapid decline of these two lines at their beginning than of the line for oats—more rapid than the ascent of that for wheat.

The whole may be generalized to the effect that where chinch-bug injury is *beginning* merely, and is not yet very serious, it will be greater where wheat is more abundant and where oats, corn, and grass are less so—especially the latter two; but that as the insect damage gradually becomes overwhelming, the wheat area may be expected to diminish slowly with the heavier grades of loss, the area in oats increasing rapidly at the same time, and corn and grass likewise finally taking an upward turn. Otherwise stated, those districts in which most wheat is raised feel the damage first and most severely; those in which wheat and oats are the principal crops next receive the brunt of the insect attack; and the last to be seriously affected are those in which corn and grass are the leading products.

In brief, the lines on these two diagrams illustrate, in the first part of their course,—that really representing Central Illinois,—the normal relations of an at least fairly healthy agriculture; while in the last part they tell the sad tale of an increasingly deadly, an almost overwhelming, malady. The decline of the wheat line shows the ruin of wheat culture impending, if not almost accomplished in 1887; and the successive rise of the lines for the other crops shows from what sources the chinch bug was then drawing its principal support, and which crops it would next attack most heavily.*

The rules of practice to be drawn from the foregoing conclusions are as follows: 1. Whatever may be done by cropping against the chinch bug must be done early or not at all. If action be delayed year after year until these insects become excessively numerous, the abandonment of wheat or other special crops will do no good, and, taken alone, may do great harm. In short, this is a preventive rather than a remedial measure. 2. In the beginning of an outbreak, the acreage in wheat, barley, and rye should be promptly reduced or those crops should be wholly abandoned. 3. If the chinch bug continues to increase, the oats area should be rapidly diminished,—corn and grass remaining the principal dependence, and clover being substituted for the latter wherever practicable.

* It may possibly be objected to this reasoning, that since the relation demonstrated between the highest grades of chinch bug injury and a peculiar distribution of the principal farm crops is one of coincidence only, it may be that the peculiar cropping is an *effect* of the chinch-bug injury but not in any sense a cause,—that, in other words, the farmers of the worst infested regions are attempting to protect themselves against the chinch bug by lessening the wheat area, and increasing that in oats first, and afterwards that in corn and grass. If this be so, we shall find, on comparing the areas of 1886 with those of 1887, that the oats acreage of 1887 is not only larger than that for 1886, but that the ratio of increase is notably greater in those townships where chinch-bug damage is very high than in those where it is but moderate; and the same may be said of corn and grass. A careful comparison of the crop reports from Southern Illinois for these two years shows no such relation. The area in all the crops is greater (as already remarked) in 1887 than in 1886,—that is, the population is increasing and the woodlands are being cleared up; but the ratio of increase for the above crops is not greater in the worst infested counties than in those less damaged.

As these last are the stock-feeding crops, the facts may be otherwise generalized by saying that a stock country is much less liable to damage by the chinch bug than one in which the small grains are the staple crops.

SUMMARY OF CURRENT OPINION.

Before leaving this subject it may be well to give an abstract of the opinions respecting wheat culture and the chinch bug expressed by economic entomologists, and by the township assessors replying to my inquiry, as given on page 11.

The only published mention of this subject by Dr. Asa Fitch which I have seen, is contained in his second report as State Entomologist of New York (1856), p. 279, where he says, without committing himself personally, that crops were so destroyed in some districts of North Carolina in 1785, or shortly after, that farmers were obliged to wholly abandon the sowing of wheat; and that again in 1809 the insects were reported to have been subdued by the abandonment of wheat for two years.

Dr. Wm. Le Baron, the second State Entomologist of Illinois, writes in the "Prairie Farmer," September 2, 1871, "Chinch bugs originate almost exclusively in spring wheat or barley, and we have it in our power, if driven to this necessity, of getting rid of these destructive insects, and keeping clear of them, by abandoning the raising of these two kinds of grain." In his second entomological report (for 1871), page 154, he remarks that "we always have it in our power to get rid of these pests by the abandonment of these two kinds of grain [spring wheat and barley] for one or two years; but to make this course effective, there must be a concert of action by farmers over a considerable section of country."

The editors of the "American Entomologist," B. D. Walsh and C. V. Riley, say in Volume I. (1869), of that journal, page 171 "At last western farmers will be compelled, as those of North Carolina have already several times been compelled, to quit growing wheat altogether for a term of years;" and in his Seventh Report as State Entomologist of Missouri (for 1874), p. 36, Dr. Riley remarks that "if in late winter the bugs are known to be numerous, it will be well to plant no spring wheat or barley."

Dr. Cyrus Thomas, the third State Entomologist of Illinois, writing of this matter in Bulletin 5 of the American Entomological Commission (1879), p. 40, regards the plan of abandoning wheat culture as impracticable, and seriously doubts whether it will be of any real advantage, if we take into consideration the loss of the crop. "That it will be of no permanent benefit," he adds, "I think must be admitted by every one who is acquainted with the habits of the species. In order that the remedy be made effectual it would be necessary to transform our land into a desert."

In January, 1881, discussing in the "Farmers' Review" (Jan. 20, p. 35), the probabilities of injury by chinch bugs in Kansas and Nebraska, and giving advice as to the best methods of cropping

against them, Dr. Thomas suggests the propriety of sowing winter wheat and of lessening the area planted in corn, basing this recommendation on the supposition that corn and spring wheat are the crops which assist more in their development than any others. He further advises the farmers of Nebraska, *first*, to devote their attention, as largely as it can be profitably done, to stock-raising * * *; *second*, to rely upon winter wheat as their chief money crop, if it can be successfully grown; and to substitute oats, as far as possible, for corn. * * * "But one thing," he adds, "is certain—that to counteract them the corn and spring-wheat crops should be reduced to as small an area as possible." Later in the same year (Farmers' Review Nov. 24, 1881, p. 322), he advises the planting of a smaller area of corn in the latitude of Central and Southern Illinois in years when meteorological conditions indicate danger from chinch bugs.

In the Transactions of the Illinois State Horticultural Society for 1881, p. 43, Dr. Thomas remarks that the most effectual method of combating the chinch bug is, beyond a doubt, to crop against it, to cease raising so much corn and to rely on oats, grass, and other crops; and in the same "Transactions" for 1882 (p. 48), he is reported by the secretary as saying that the chinch bug must perish if the growing of winter wheat and corn are abandoned.

Prof. Herbert Osborn, of the Iowa Agricultural College, recommends, in a bulletin of that institution published in January, 1888, p. 11, that the area planted to wheat, rye, barley, and Hungarian grass be reduced as much as possible.

In the latest general publication respecting the chinch bug, that by Mr. L. O. Howard, assistant to Dr. Riley, in Bulletin 17 of the U. S. Department of Agriculture (1888), p. 34, "diversified farming with wheat mainly left out" is approved as "the exemplification of condensed wisdom." "The object of the omission of wheat," he says, "particularly winter wheat, is, of course, to afford as little food as possible for the first generation. * * * The one great result of the chinch-bug convention held in Kansas in 1881 was the adoption of a resolution to abstain from the cultivation of wheat, the length of time not being mentioned. As we have previously shown, large areas of oats could be successfully grown, but in corn-growing regions most small grains must be left alone, and, above all, winter wheat and barley."

My own earlier utterances on this subject, I find to be as follows:—

Receiving July, 1886, a letter from Clinton county, Illinois, saying that crops there had been eaten up by the chinch bugs during the last two years and inquiring whether the abandonment of fall wheat will rid the farmer of them, I replied, in a letter published in the "Prairie Farmer," of Chicago, for July 31, "I know nothing

from my own observation of the chinch bugs to lead me to believe that you will escape them by giving up winter wheat as a crop. Certainly they have been fearfully destructive in the northern part of the State at times when winter wheat was not at all raised there, laying their eggs freely in spring wheat, barley, etc., and the fact that I personally know them to deposit their eggs abundantly in spring in oats and corn, and to breed there apparently no less freely than in wheat, makes it very unlikely that they are limited to any [one] of the small grains as a means of support to the first brood."

Next, in a circular concerning the chinch bug in Illinois, issued September 10, 1886, page 5, I said:

"The leading remedial and preventive measures are as follows:—

"1. The abandonment of small grain for a year in regions where corn is the principal crop, in the hope that the bugs of the first brood will thus be starved out. Where this experiment is tried it will be necessary for a fair chance of success that *no* small grain be sowed (since, as already said, the bugs will breed in oats); that the planting of corn be postponed as late as practicable, else the bugs will surely breed in that with very destructive effect; and that no millet or Hungarian grass be sown early enough to afford food and breeding places to the hibernating brood after they emerge from their winter retreats."

Finally, on page 35 of Bulletin 2 of the entomological office, issued in 1887, I have mentioned under the head of Agricultural Methods, "the temporary abandonment, in corn districts, of small grain, especially wheat and barley. This measure of defence, in use for more than a century, is the one most generally relied upon. Its at least partial efficacy is now clearly demonstrated throughout a large part of this State where the chinch bug is making its advent almost wholly by way of fields of wheat and barley. It is to be noted, however, that when the number of this insect has risen to great excess, it can not be reduced again by simply refraining from the culture of wheat and barley. It has been repeatedly shown in Southern Illinois, during the last two years, that under such circumstances the bugs will breed as freely and successfully in oats as in other grains; while recent occurrences in New York prove that the meadow grasses afford them almost equal opportunity." On page 42 of the same bulletin, as a special procedure recommended for Northern and Western Illinois, where the chinch bug was only beginning to attract attention, I mention the abandonment of wheat, rye, barley, Hungarian, and millet for the coming year, or, if grown, the sowing of timothy and clover with the wheat.

My township correspondents, while not unanimous, were usually of the opinion that chinch bugs were most abundant in neighborhoods where wheat was grown,—more generally so in the southern part of the State than in the other sections. Thirty-nine replies

to my inquiry on this point* were received from Northern Illinois, of which 30 were affirmative (77 per cent.); 54 from the Central part of the State, of which 40 were affirmative (74 per cent.); and 117 from Southern Illinois, 105 affirmative (90 per cent.).

EXPERIMENTS.

Fertilization.—The fact that the chinch-bug attack affects most seriously the vegetation of the poorest soils, that crops on rich land will often escape damage while those on poor land adjoining it may be completely destroyed, is well enough known from common observation. Not unfrequently different areas in the same field will illustrate this difference in unmistakable terms, especially if some parts of the field receive the “wash” from others. The lack, however, of precise evidence respecting the degree of benefit to be derived in an infested region from the use of fertilizers as a support to the crop against chinch-bug attack, led me to undertake, in 1887, a field experiment. Through the kindness of Samuel Bartley, Esq., of Edgewood, Effingham county (who gave the matter his personal care throughout the season), I was enabled to make this test on a small field of his wheat.

This plot, after plowing in fall, had received a top dressing of manure taken from stock yard, stable, hog-pen, and poultry house, the ground never having been fertilized before. On the 3d of May I found an extraordinary number of adult chinch bugs in this wheat, just beginning to lay their eggs. So overwhelming was their attack that Mr. Bartley compared the noise of their flight, as they entered the grain, to that of a swarm of bees. Even at this early season the wheat was seriously affected, the plants reddened and dwarfed in patches, and the growth diminished, as I estimated, about one third. On a measured part of this plot, commercial fertilizers were sown at the rate of one hundred pounds each per acre of nitrate of soda, superphosphates, and sulphate of potash. The wheat from both parts of the field was harvested and threshed by hand, kept carefully separate, measured, and weighed, the general result being that for the portion fertilized with barn-yard manure alone, the yield, notwithstanding the enormous attack by the chinch bugs and their continuance throughout the season, amounted to 20.8 bushels per acre of wheat that weighed 54 pounds to the bushel; while that treated with commercial fertilizers in addition, yielded at the rate of 24 bushels per acre of grain weighing 62 pounds to the bushel. The result of this experiment was especially noteworthy, as 15 bushels per acre is considered in that region a good average crop. On another field of badly worn land less than half a mile from our experimental plot, (the only other wheat in the neighborhood,) a similar application of the commercial fertilizers, produced a marked improvement in the beginning of the season, in size and color of the plant, but later the whole succumbed to the chinch-bug.

* See p. 11.

Much more elaborate experiments were planned for 1887 and 1888, plots being secured for the purpose on the farms of Mr. Andrew McMurray and Mr. George Corson, near Tonti, in Marion county. These plots, properly subdivided, were treated in September 1887, (1) with stable manure, (2) with phosphates, (3) with potash, (4) with stable manure and phosphates, (5) with stable manure and potash, (6) with phosphates and potash, and (7) with all three of these fertilizers together, (8) with sulphate of ammonia alone, (9) with ammonia and potash, (10) with ammonia and phosphates, and (11) with ammonia, phosphates, and potash combined. The grain was all heavily infested by the chinch bug, but the general winter-killing of the wheat, leaving a very light and unequal stand, so far destroyed the value of these experiments that they are not worthy of detailed description.

A critical comparison of the plots on Mr. Corson's land, made January 29, after the grain was ripe, gave the following general results, of value only as indications of the direction in which future experiments may best be made:—

1. The plot, (one tenth of an acre) treated with phosphates alone (200 pounds to the acre)* bore about twice as much wheat as that treated with potash alone, and the growth was taller, stronger, and more thrifty.

2. The addition of potash to the phosphates made no appreciable difference in the appearance of the grain.

3. I could not see that the plot treated with potash alone differed especially from the plots on which nothing was used.

4. That on which ammonia was applied alone was but little better than the potash plot.

5. That on which ammonia and potash were combined (200 pounds each to the acre) bore probably twice as much wheat as either plot where these were separately used.

6. The plots with ammonia and phosphates combined were decidedly and conspicuously the best of the lot,—a difference easily seen at a distance, and to their very margins. There was probably three times as much wheat on these as on the ground adjacent, which had not been fertilized. The wheat was also clearly heavier.

From the above it appears, as a matter of judgment, but not of exact experiment, that neither potash nor ammonia alone was of much value on the soil as a fertilizer for wheat attacked by chinch bugs, but that the two combined about doubled the crop; that phosphates alone produced a noticeable effect; and that ammonia and the phosphates formed the best combination for wheat under the circumstances there appearing, potash adding little or nothing to the value of this combination.

Timothy seed had been sown on all three plots in fall, but grew poorly on most, owing chiefly to the chinch bug damage. The

*This was the ration of each of the commercial fertilizers, wherever applied.

phosphate fertilizers were evidently the best of the three for grass; but far the heaviest yield of all was borne where all three fertilizers were combined.

INSECTICIDES.

Kerosene emulsion.—My experiments with the kerosene emulsions, made in 1882, and described in my entomological report for that year,* have since been repeated substantially by Prof. Atkinson of North Carolina, by Prof. Herbert Osborn, in Iowa,† and by several farmers of my acquaintance. Prof. Osborn's results confirm, in general, my own, as shown by the following extracts from his report:—

"The first trial was made July 15, the emulsion used being the common one, consisting of kerosene, soap, and water, diluted to about five per cent. kerosene. The bugs were killed very quickly by this application, and great numbers of them could be reached, but many in particularly secreted places, in folds of leaves and under lumps of earth, escaped. Thrown on to the leaves and running down between leaf and stalk, it dislodged and killed immense numbers. Thrown against stalks where they were congregated, it would quickly dislodge the mass, and while it was impossible to see whether all driven off in this way were sufficiently wet to kill them, it was certain that most of them were. This application was at the rate of about 1 gallon of the emulsion or 12 gallons of the diluted mixture to five rows of corn for 32 rods, or what would equal five gallons of emulsion, 60 gallons of diluted mixture to the acre, or a cost for material of less than 60 cents per acre. * *

"On August 15 applied kerosene emulsion to bugs accumulating on corn, using an emulsion diluted to contain about 6 per cent. kerosene and spraying with cyclone nozzle. Great numbers of bugs could be found dead within a few minutes after application, and on the following day hosts of dead could be found on the ground around the hills treated. In places, however, the stalks had become well covered by live bugs that had moved in to fill the places of the slain.

"Subsequently the farm department applied it on a larger scale, using 5 to 6 per cent. emulsion, and spraying from barrels in a wagon, one man working the force pump and another manipulating the hose and cyclone nozzle, walking rapidly among the hills of corn and directing the spray upon the masses of bugs. This resulted in the destruction of great numbers. * * *

*Twelfth Report of the State Entomologist of Illinois, pp. 59-63.

†"The Chinch Bug: A General Summary of its History, Habits, Enemies, and of the Remedies and Preventives to be used against it."—By L. O. Howard. Bull. No. 17, U. S. Dept. Agr., Div. of Entomology, p. 41.

"The use of kerosene can hardly be expected to prove of value except when the bugs are massing on corn. At this time, application to an acre or two of the field next to stubble may do much to save the rest of the field."

Prof. Osborn estimates the necessary cost of a thorough spraying to be about seventy cents an acre—thirty cents for material and forty cents for labor.

Prof. Atkinson also reported "perfect success" with the same application, reaching the conclusion that "there is no reason why all should not get rid of the chinch bug on corn, for a failure to kill the bugs would arise from some fault in the application, and the application can be made cheaper than a dressing of the corn could be made with a hoe."

From the office correspondence the following items of interest are taken.

Mr. L. B. Sidway, of 182 Dearborn Street, Chicago, writes under date of August 6, 1888, as follows:—

"I have seen the kerosene emulsion, as recommended on page 41 of your report on chinch bugs—1888—tried with these results:—

"1. F. Hultgren, Verona, Lawrence Co., Mo.:

"At the beginning of wheat harvest the bugs went into his corn, and he at once applied the emulsion. The bugs not killed left he field.

"2. G. D. Sidway, Purdy, Barry Co., Mo.:

"The bugs had got into first four rows of corn. Applied emulsion and supposed all were killed. Two days later found them a little farther in the field, and applied emulsion—beginning two or three rows ahead of any bugs—and has seen no more in the field.

"3. At my own place, Godfrey, Madison Co., Ill.:

"The bugs had gone into corn about thirty rows, and were in great numbers. Applied emulsion and have seen no more bugs—now two weeks.

"I think this formula a cheap, easy, and very effective method of killing the chinch bug in corn. Its use may easily be worth more to Illinois in one year than the Agricultural Department costs the State in twenty."

A farmer of Edwards county, Dr. Bristow, living near Albion, reported personally that he had protected his corn by the use of the kerosene emulsion diluted to contain four or five per cent. of kerosene, applying it twice a day to the four or five outer rows, covered with bugs from wheat adjoining. The insecticide was applied at first with a wisp of broom corn, but afterwards simply thrown upon the stalks with the hand.

Mr. Samuel Bartley, of Edgewood, Effingham county, also writes me, November 20, that he used the emulsion this season (1888) with entire success in connection with ditches to arrest the progress of the bugs.*

On the other hand, a letter from Hon. E. S. Wilson, of Olney, dated July 17, 1888, informs me that, while the emulsion kills the bugs that are on the corn at the time, others come on it at once; and that he does not know of a single man who had saved his corn where he had used the emulsion.

It will be seen, however, that it was here used under the mistaken idea that, once applied, it will act as a permanent repellent. Where chinch bugs are excessively numerous, it should be used subordinate to some method for the exclusion of the insects from the field, and applied to those accumulating on the outer rows of corn wherever they succeed in making their way across the barriers interposed.

Where the attack is less severe, the emulsion may be applied alone after the movement of invasion is substantially complete, to destroy the chinch bugs along the edges of the field. Indeed, it is not impossible that it may be economically distributed to corn throughout the field, after the hatching of the second brood, for the destruction of the young that do the later damage. If this can be done at a cost of seventy cents per acre, there are many circumstances under which it could hardly fail to be profitable.

Dr. R. S. Peyton, of Pinckneyville, writes me of a can, carried on the back, with which he finds that he can work over two or three acres per day with the kerosene emulsion or hot water, besides hauling and heating the water in the field. It is possible that kerosene, either pure or in the form of an emulsion more or less diluted, might be mingled with fertilizers, liquid or dry, and thus distributed to *wheat* in a way to combine the beneficial effects of both applications with no additional labor.

Tobacco water.—Thinking it possible that some preparation cheaper than the kerosene emulsion might be found equally available for use, I directed experiments in August, 1888, with various insecticides, the most satisfactory of which were those with tobacco water.

A strong decoction of the stems being made, August 14, a number of chinch bugs, placed on a cloth moistened with this fluid, were thoroughly stupefied in an hour, and dead in an hour and a half. Tobacco water of this strength repeatedly applied as freely as possible had no effect on growing grass.

August 15, nine bugs were treated as above, removed when wet with the tobacco water, and placed in a bag of cheese cloth. Examined 22 hours later, six were found dead and the remaining three alive.

*See his letter near the close of this article, under the head of Miscellaneous Notes and Observations.

The same day 16 chinch bugs were placed on a grass plant, the whole thoroughly wet with tobacco water, and placed under a bell jar. In an hour nine bugs were apparently dead, and in 16 hours all were dead but one.

On the other hand, eight chinch bugs sprayed on a plant of grass and enclosed, with the plant, in a cheese-cloth bag, were all alive four hours later.

September 4, 17 bugs treated like the lot last mentioned, were all dead but one in 24 hours.

September 6, 12 bugs treated as above; in 26 hours seven were dead, five alive.

September 6, 69 bugs were placed in a bag of cheese cloth, and thoroughly wet with tobacco water, and a potted grass plant was also thoroughly sprayed, together with the surface of the ground about it. The bugs and plant were then placed together in a netting bag and kept for 25 hours, at which time four were able to crawl, five others showed signs of life, and 60 were dead. Three were already imbedded in one of the fungi of disease, showing the presence of this contagion among our experimental lots, and, to some extent, vitiating all our results.

From the above it is evident that this fluid is less effective than the kerosene emulsion, but may still be deserving of further experiment.

Lobelia water.—A strong decoction of lobelia, applied August 5, produced no effect in twenty-four hours.

Coal-tar water.—Water in which coal-tar had been stirred and shaken until saturated with the soluble parts of the tar, was found to have but slight effect. Of fifteen adult chinch bugs sprayed on a grass plant, August 14, only one was dead next day and that by accident.

August 15, a similar experiment made with twenty-two chinch bugs (adults), had a similar result—not one was killed.

August 16, twenty-two adults were treated as above, except that the fluid was prepared by boiling tar in water. Only two were dead in twenty-four hours.

Another lot of bugs, sprayed with tar water September 4, were all alive but one (young) twenty-four hours later. A number of young larvæ similarly treated were killed, but pupæ were not affected.

A small corn plant thoroughly wet with tar water August 13, was quite unaffected twenty-four hours later, and the same result was obtained in another experiment with an application of tar water to corn in the field, no trace of injury appearing within forty-eight hours.

Although worthless if applied alone, this fluid may be found useful as a diluent of others.

Coal-tar emulsion.—An emulsion of coal-tar with soap-suds, which we made like that with kerosene—using, however, only one third coal-tar to two thirds soap-suds and diluting this with water, nine parts to one,—was found to approximate the kerosene emulsion in its action on both insect and plant.

Twenty-five bugs were placed, September 6, on a grass plant, in a small pot, and thoroughly wet with this coal-tar preparation. In an hour and a quarter many of these bugs seemed dead. In seventeen hours twelve were dead, six showed signs of life, and seven were able to crawl. In twenty-four hours sixteen were dead, eight were barely alive, and but one was able to crawl.

Another experiment made the same day was less conclusive, only seven of twenty-six bugs treated as above being dead in twenty-two hours.

Young oats completely soaked with this emulsion showed evident injury two days afterward, but continued to grow, and two months later were as thrifty as those adjoining.

This emulsion deserves further experiment, especially as our trials were made with a weak dilution,—about three per cent. coal-tar. It is much cheaper than the kerosene emulsion, coal-tar being only about five cents a gallon; but it is somewhat more troublesome to handle. The making of the emulsion may be facilitated, however, by boiling tar and suds together before mixing with the pump.

Turpentine emulsion.—A single experiment was made, September 4, with an emulsion of turpentine in soap-suds, diluted with water to contain three per cent. of turpentine. Twenty-five hours after application, six bugs out of ten sprayed on a grass plant were dead, and the four remaining alive.

Lime-water.—Two experiments, one each with common lime-water and with water from gas lime, were entirely without result. Chinch bugs treated thoroughly with these fluids were all alive twenty-four hours later.

Gas lime.—Two experiments served to show that bugs will, if necessary, travel across a narrow belt of fresh gas-lime (about two inches wide) without appreciable injury, either at the time or subsequently.

Arsenic.—The reported results of a casual experiment made with London purple by a farmer who supposed that the chinch bug was as liable to poisoning by this substance as the potato-beetle, led me to a partial test of the arsenical poisons.

September 6, thirty-one chinch bugs, larvæ and pupæ, were dusted with powdered arsenic in a bottle containing also some grass blades, and confined there by a piece of netting over the bottle's mouth. In twenty-four hours all but three were dead, these being still able to crawl.

London purple.—Of twenty-two bugs placed on a potted grass plant, dusted, plant and all, with London purple and enclosed in a netting bag, eighteen were dead and four alive at the end of seventeen hours.

September 10. In a similar experiment on twenty-four bugs, but six were found dead in sixteen hours.

Paris green.—September 9. In a like experiment with chinch bugs confined with growing grass and dusted thoroughly with Paris green, but five were dead out of twenty at the end of forty hours. In another, only three were found dead out of nineteen.

Check lots of bugs not poisoned, showed at this time such a susceptibility to confinement, owing probably to the existence of disease among them, that little value can be attached to these results. It is clear, at best, that only the arsenic can in any case be worth considering.

Egyptian insecticide.—This substance, received from the manufacturers,* was applied very freely to corn in the field, at Albion, Illinois, August 21, 1888, being sprinkled thoroughly on stalks and leaves, and behind the leaf sheaths. Nine and a half hours afterwards the bugs were feeding as before, apparently not affected; but a very heavy rain following, which washed the insecticide down behind the leaves, the bugs on this corn seemed to be diminished in number at the end of forty-eight hours. In seventy-two hours a few were found dead, but those living were as active as before. The corn rows treated were, however, clearly less abundantly infested after the rain than those adjacent.

On the other hand, the dry powder applied very freely to six bugs confined with a grass plant had not taken visible effect in twenty-eight hours.

Buhach.—In a single experiment with this powder applied dry in the usual manner, all the bugs died within twenty-five hours.

Corrosive sublimate.—An aqueous solution made with two grains of corrosive sublimate to six ounces of water, had no effect on chinch bugs in two experiments, sixteen and twenty-four hours after thorough application.

Steam.—At the St. Clair county fair, in Belleville, September 11, 1888, Mr. George C. Bunsen, of that town, reported in the course of remarks on the chinch bug, the successful use of steam thrown against the stalks of corn from an apparatus of his invention. Experiments subsequently made at the office showed that with sufficient care steam may be used to kill chinch bugs without injury to the plants on which they are exposed; but as the difference is slight between the time needed to kill or disable the insects and that sufficing to damage vegetable tissues (very slight if the vegetation is at all fresh), the care required will usually be such as to make the method impracticable in field operations. It

*Egyptian Insecticide Co., 203 Pine Street, St. Louis.

might possibly be used, however, with a proper apparatus, against the hard and partly dead stalks and lower leaves, to kill such chinch bugs as were not in any way protected from its momentary contact.

Our experiments were as follows: Varying numbers of chinch bugs, adult and young, were rapidly deadened September 13, 1888, by a very few seconds' exposure to steam thrown against them through a half-inch rubber tube as they rested on a sheet of paper. A few hours later most of them showed signs of reviving life, but the next day all were dead.

Other insects exposed to the steam jet were as readily killed: maple plant lice in one or two seconds—the leaves bearing them remaining uninjured; grasshoppers and blister beetles (*Epicauta*) in six or seven seconds.

Steam was passed rapidly over a young foliage plant (*Coleus*) for seven seconds without noticeable injury; but growing oats showed slight injury after three seconds' steaming and with longer exposure was much damaged.

Application of steam to shrubs and trees seemed to be impracticable, because of the difficulty of equal distribution. If used in large quantities the steam would kill the leaves nearest the jet before insects on others were affected, and if in smaller quantities the time and care required to throw it uniformly against all surfaces and from various directions would make it much less effective and convenient than a fluid spray.

BARRIERS TO MIGRATION.

Coal-tar.—The use of coal-tar as a barrier to the passage of the bugs from field to field at harvest time, is a well-known and highly valuable measure, one of the most important in the list of defences against this insect, but has the practical disadvantage that the belt of tar poured along the ground or painted on boards speedily dries out, and must be renewed in hot weather two or three times a day, or even oftener, to completely prevent the passage of the bugs.

Chinch bugs surrounded with a line of fresh tar will sometimes escape by wading through it, but all such bugs die in an hour or so, as we have determined by capturing and confining them under observation.

Coal-tar and oil.—To retard the drying of the tar, it may be mixed with oil or other grease, machine oil being perhaps the cheapest for common use. Soap grease, tried out, would doubtless answer the same purpose.

The advantage of this mixture is shown by some experiments made at the office in August and September, 1888, when tar, unmixed, poured on paper and placed in the hot sunshine, dried in half an hour so that bugs could cross it here and there without daubing their feet; while a mixture of one tenth linseed

oil and nine tenths coal-tar was so sticky after 72 hours that chinch bugs could not cross it, and even at the end of 96 hours still served its purpose. Mixtures of one fifth oil with coal-tar, and of equal parts of each, were found much less satisfactory. Diluted with one tenth oil, tar is too fluid to use upon the ground, as it speedily soaks in; and consequently if this mixture be used, boards must be placed around the field either set on edge or, preferably, laid flat, a little strip of ground having been first prepared so that they may be sufficiently bedded in the earth to keep the bugs from passing beneath them.

As a more convenient and effective means of maintaining a coal-tar barrier, I suggest that strips of sheet iron bent at the top to form a gutter about one inch across and half an inch in depth at the middle, be placed end to end, slightly overlapping, the tar to be poured in this gutter. If necessary to prevent too free an escape at the joints, it may be slightly thickened by stirring in dust. Small pits sunk at intervals along a barrier of this description would gather the chinch bugs in great numbers, where they could be readily killed with a little kerosene and water, or by mechanical methods.

STARVATION EXPERIMENTS.

To ascertain how long the chinch bug in its different stages may live without feeding (a point applying to several field methods of contest with this insect) we confined, September 4, under a bell jar, without food, a miscellaneous lot of bugs of various ages, from the very young of the first stage to adults more than a week old. In twenty-four hours a few of the youngest were dead, and in twenty-eight hours, one adult. In forty-eight hours a number of adults, larvæ, and pupæ, were dead, and September 7, many more of the last, and almost all the larvæ. September 8, only a very few adults and a few pupæ remained; September 9 five adults were still living, all the others dead; and September 10, six days after beginning, all were dead but one adult.

This experiment is open to the objection that the bugs were on a table in the office, and the dryness of the air may have had much to do with their death; and as no check lot was separated, it is impossible to say that these specimens were not suffering from one of the diseases prevalent at the time in the region from which they came.

In an experiment begun August 13, with young bugs, taken as fast as they hatched from the egg and confined without food, none lived twenty-four hours, but most died within twelve. These eggs began to hatch when fifteen days old.

A variation in this experiment consisted in burying lots of chinch bugs at the depth practicable by plowing, and examining at intervals to determine their condition.

August 13, two lots of larvæ and pupæ were buried two inches deep, one with food and one without. Forty-eight hours afterward both were uncovered and found uninjured, and seventy-two

hours after burial all were still alive, no difference appearing between the two lots. Heavy rains, about twenty-five hours long in all, had occurred during the interval.

September 3, a similar experiment was made with both old and young, two lots of chinch bugs being buried five and six inches deep, respectively, with grass in an earthen pot, the earth being firmly pressed down over them. Ten days later, both young and old were still alive.

September 5, three lots were buried in pots with grass, one three inches deep, one five inches, and the third six. Five days later those of the first lot had not yet crawled out of the earth, but were still alive. In the second lot many had come to the surface, but in the third, six inches deep, none had crawled out, though all were living. The earth was packed over all these lots to imitate rolling in the field. The late period at which these experiments were made and the consequent possible preparation of the bugs for their hibernating fast, may have had something to do with the failure of this method of starvation.*

CONTAGIOUS DISEASE.

In my first entomological report† an account was given of a newly detected disease of the chinch bug characterized by the presence of bacteria in great numbers in the alimentary canal, my observations on which were made almost wholly at Normal, in McLean county, and at Champaign.‡ In the same report I referred to chinch bugs found dead in fields of corn at Jacksonville, September, 1882, imbedded in a white fungus which proved, on examination by Prof. Burrill, to be an *Entomophthora* (*Empusa*). Other bugs similarly situated were found at Normal, some of which seemed to have died from other causes, the fungi imbedding them having the characters of a common mold; but a slide made from one of these insects, still in my possession, contains a quantity of unmistakable *Entomophthora*.**

During the still existing chinch-bug outbreak, we have closely watched for the appearance of these diseases, bugs having been crushed occasionally for study of their fluids, and all dead specimens found being brought to the office and examined with reference to the presence of parasitic fungi in their bodies.

*An observation reported by Mr. E. M. Shelton, Director of the Kansas Agricultural Experiment Station, in their Bulletin 4, throws light upon the effect of burial by plowing. Chinch bugs plowed under with young wheat to a depth of eight inches May 9 and 10,—the ground being afterward harrowed and repeatedly rolled,—nevertheless emerged in enormous numbers, (some having apparently hatched in the earth,) escaped from the plots, and attacked adjacent crops.

†Twelfth Report of the State Entomologist of Illinois (1882) pp. 47–51.

‡This chinch-bug microbe was found in bugs collected in Central Illinois in May of the following year (1883), and may have had its share in a still further reduction of the numbers of chinch bugs in that region, apparent each year until 1887.

**In an article on "The Chinch Bug and the Season," published in the "Prairie Farmer" of Chicago, for November 25, 1882, Prof. E. A. Popenoe, of the Kansas Agricultural College, says that farmers of Southeastern Kansas had recently reported to him the death of all the chinch bugs in their corn,—the dead bugs being collected about the foot of the stalks, and each covered with a strong growth of white mold.

The first clearly recognizable cases of fungous disease among these chinch bugs were found by me in a corn field near Shattuc, Clinton county, July 7, 1887, but as the fungus affecting these insects was not an *Empusa*, but belonged to a genus (*Botrytis*) but very rarely parasitic, no especial attention was paid to it at the time. The same fungous affection was next noticed August 7, 1888, at Flora, Illinois. September 13, the *Empusa* of 1882 was collected in Marion county; and September 14, the bacterial form discovered in 1882 was observed in immense numbers in the intestines of chinch bugs obtained at Odin.

With this inspiring evidence that at least three kinds of disease were at work on the chinch bugs of Southern Illinois, active measures were taken at once for the fullest possible study of them from every point of view, entomological, bacterial, and economic.

Without attempting at this time a full account of our work (still in progress), I give a few items bearing especially on the distribution and activity of these diseases in the State.

The field at Odin where the bacterial disease was first detected, contained only a very moderate number of chinch bugs for the time and circumstances, and these very unequally distributed. The number of adults, especially, was relatively very small. The bugs had also a feeble vitality, as shown by the rapidity with which they died in transit, although put up with special care. Many pupæ were very sluggish, moving slowly along as if stiff and feeble, the abdomens noticeably distended and unusually greenish beneath.

Crushing both dead and living examples, and slightly diluting the fluids with distilled water, immense numbers of bacteria were apparent, moving without flagellar action, unmistakably the same as those studied in 1882.

Collected in a film on a cover glass, dried, flamed, stained with aniline and mounted in balsam, these bacteria had the appearance of a short-jointed bacillus, with a pale center which did not take the stain. If the fluids were not much pressed or agitated, there were usually visible many globular masses of these bacilli, looking like free nuclei, but readily broken up by repeated pressure, the separate individuals swarming everywhere. Sometimes careful crushing in water would enable one to trace the streams of escaping bacteria to a portion of the alimentary canal protruding through a break in the crust.

On the 18th of September, I killed carefully and at once dissected a pupa from Odin, presenting the symptoms of disease. First crushing on the slide portions of the fatty bodies, I recognized a small number of the usual bacilli, but when I isolated portions of the gastric cœca*, transferred to a clean slide, and

*The chinch bug has, besides the slender Malpighian tubules, five large cœca arising some distance anterior to these, which remind one of the so-called hepatic cœca of the cockroach.

crushed carefully in place, I found the fluid swarming with immense numbers of bacilli, saw others rapidly escaping in streams from the torn tubes or dancing about within them, and found the nuclei of the epithelial cells seemingly closely packed with the same bacteria. Curiously, on carefully isolating and crushing on still another slide, the anterior part of the alimentary canal—that preceding the cœca—I could not find a single microbe. The posterior part contained, however, a moderate number, demonstrated in the same manner. Another specimen, studied by the same methods, contained vast numbers of the characteristic bacillus in the cœca, but none that I could clearly recognize in the other parts of the alimentary canal. They were wanting in the Malpighian tubules.

Examples collected September 19, in corn fields at Albion, in Edwards county, contained sometimes more and sometimes fewer of these bacteria, and occasionally none; others from Ashley, obtained at the same time, were moderately infested; and examples from Edgewood, received September 22, contained them, if at all, in numbers so small that I could not satisfy myself of their presence. Specimens from Mascoutah, sent September 22, contained a variable number, vast quantities occurring in some and relatively few in others. Their apparently greater number in pupæ than in imagos was possibly due to the greater ease and thoroughness with which the relatively soft bodies of the former could be crushed on the slide.

Bugs received from Bond county, October 3, were similarly examined, and found in similar condition. Of three pupæ crushed, the first contained an extraordinary number, the second a scarcely inferior abundance, and the third only a moderate quantity. Cultures made from the first of the above were completely successful, and gave conclusive evidence as to the character and life history of this bacillus.

On the other hand, and finally, three adults collected at Golconda, on the Ohio River, October 4, contained no bacteria that I could recognize. If present at all, the number was certainly very small.

From the foregoing it is apparent that this bacillus was unequally but abundantly distributed throughout the region where the chinch bug had reached its culminating point last year; but, on the other hand, its absence in specimens from Pope county, where the insect was more destructive this year than last, is of special interest and significance.

The numerous bacterial cultures made from these insects, completely successful in both fluid and solid media, may best be reported elsewhere. It is sufficient to say that they showed this chinch-bug microbe to be a bacillus, flagellate in fluid cultures and when grown on the surface of solid media, varying greatly in size and form according to place and stage of development, tend-

ing to adhere in long serpentine strings of twenty to thirty or more when actively dividing in liquids, and becoming short and broad; with pale center, when forming spores,—this center being simply the single unstained spore developed in each segment or cell.

The first examples of the entomophthorous infection certainly seen in Illinois since 1882, were obtained by us from the corn fields of Clinton county,* September 13, 1888, and the next, September 18, at Albion, where this fungous disease was, however, less prevalent than that due to *Botrytis*. Its possible occurrence in the Edgewood region was indicated by an accidental observation made September 22. When examining a pupa obtained there on the 8th of August, I found its fluids filled with fragments of the entomophthorous mycelium.

Letters and specimens from Minnesota and Iowa show the extraordinary prevalence of this affection there, where it is evidently the dominant chinch bug disease,—a condition in peculiar contrast with that of the southern part of this State, where the *Entomophthora* is relatively infrequent, and the *Botrytis* and bacterial diseases are the prevailing maladies.

Our first positive observation of the *Botrytis* disease of the chinch bug was made, as has been said already, near Shattuc, Clinton county, July 7, 1887. The specimens obtained were not critically studied at the time, and the fungus was first positively recognized as parasitic on the chinch bug August 7, 1888, on specimens obtained at Flora, in Clay county.

The occurrence of this disease on a scale sufficient to affect notably the numbers of the chinch bug, was first observed September 18 by one of my assistants, Mr. John Marten, at Albion, Edwards county. The insects were at this time much less numerous there than three or four weeks before; in some neighborhoods not more than one tenth as common. The apparent cause of this decrease was a fungous disease, the mold-covered victims of which were so freely sprinkled beneath the corn as to suggest a recent flurry of snow. On one measured area, for example, of only two square inches, twenty-six bugs were counted, covered with the fungous growth—mostly that of *Botrytis*. Mr. William Over, a local correspondent of the office, reported that this affection of the chinch bug was observed there at oats harvest.

The same *Botrytis* was detected in chinch bugs at Ashley and Nashville, in Washington county, September 18. It occurred freely in our breeding cages, where living chinch bugs were kept

*Notes made in the fields of this region July 24, 1888, make it probable that the beginnings of this disease were observed at that time, although the specimens collected show only the *Botrytis*. The occurrence was recorded, however, of numerous dead bugs, adults and pupae, imbedded in a fungus resembling that of muscardine, sometimes fastened to the leaves, sometimes beneath the sheaths, and occasionally in the dirt, as if they had been washed down by rains. In two cases, bugs were attached to the leaves by a scanty mycelium, the insects themselves showing little external fungous growth. This latter appearance is quite characteristic of *Entomophthora*. Even as far back as March 22, 1887, I noticed at Highland, in Madison county, that fully half of the chinch bugs in grass upon the headlands of fields of corn were dead, and usually covered with mold.

under conditions as favorable as possible to their maintenance. The rapid *post-mortem* development of the fungus here was quite inexplicable on any other theory than that of its pathogenic character. One specimen, for example, alive in the afternoon, but dead upon the bell glass at noon of the following day, was already completely whitened by a profuse external growth of this Botrytis, already fruiting abundantly.

Another example, but just dead, (taken from a lot of chinch bugs among which this Botrytis affection prevailed,) upon whose surface no external growth had yet appeared, was seen to be filled and penetrated everywhere with a rudimentary and rapidly growing mycelium certainly not entomophthorous, but agreeing in character with the Botrytis as this appears within the insect.

As to the distribution of this fungus outside the State, I have no knowledge beyond the fact that it appeared in a small collection of chinch bugs received from Mr. Otto Lugger, of Minnesota, October 25, 1888, within a fortnight of their arrival here,—a fact which may be explained either as due to its occurrence in Minnesota, or as a result of accidental infection at the office after the bugs arrived.

An observation of especial interest was made November 1 by Mr. Marten, at Champaign, a large beetle (*Parandra brunnea*) found dead under a log, being thickly covered with a profuse growth of this same Botrytis.

Descriptions and figures of these fungi, and fuller accounts of the diseases associated with them, may be best postponed until our studies now in progress are further advanced.

At present it appears that all except perhaps the bacterial disease are closely dependent for their activity on the weather, although their generally rapid development over so large a territory indicates their presence at all times to a greater or less extent. That the bacterial disease is less dependent upon wet weather for its activity was shown by occurrences detailed in my entomological report for 1882, borne out as these are by our office experiments this year. While in order to obtain the free and rapid development of the Entomophthora or Botrytis, it was necessary to enclose the chinch bugs under glass over moist earth, the bacterial disease appeared or continued equally well in specimens kept perfectly dry, and even where they were evidently perishing from simple drouth. However, the appearance of even this disease only after a season of considerable rain, and our failure to detect it in the field in extremely dry weather, make it probable that this also remains in abeyance under conditions recognized as especially favorable to chinch-bug increase.

That it is chiefly to the joint action of these various disease-producing fungi, favored as they are by moist weather, that we owe the disappearance of chinch-bug outbreaks, is rendered almost certain by the facts now on record.

MISCELLANEOUS NOTES AND OBSERVATIONS.

Food experiment. The sole recorded exception to the generalization that the natural food of the chinch bug consists of species of grasses only, is that reported by Mr. Lawrence Bruner,* from Nebraska, according to whose observations one of the common species of *Polygonum* (wild buckwheat) was found infested by the bugs.

A large lot of chinch bugs placed with a growing plant of *Polygonum dumetorum*, September 5, 1888, seemed at first to try to feed upon it, although close observation gave no positive evidence that they actually did so. Later they paid little attention to it, and in five days nearly all had died, chiefly in the bottom of the bell glass, where they had spent most of their time. The plant grew thriftily, and gave no evidence of attack.

Early occurrence of the chinch bug in Illinois.—From W. T. Shelby, Esq., police magistrate and notary public at Olney, Illinois, born in Edwards county in 1820, I learned that the chinch bug destroyed a field of his father's corn in 1828, on a place opened up about 1816, seven miles north of Albion. The insects covered the stalks so thickly that cattle did not like the fodder. This antedates by 12 years the earliest previously recorded occurrence of the chinch bug in Illinois,† and by three years its description by Say, who lived then, and had lived for six years previously, at New Harmony, Indiana, only about 25 miles from the locality above mentioned. It is an interesting circumstance that Say's knowledge of this insect was based on a single specimen obtained on the eastern shore of Virginia‡.

Effect of the chinch bug on grain and corn.—The fact seems not to have been generally noticed that both small grain and corn are frequently prostrated by chinch-bug attack,—the former much as if infested by the Hessian fly. Corn evidently falls from lack of "brace roots," whose development is arrested by the chinch bugs which collect at the base of the stalks and drain the roots as they put forth. The injury thus done is not measured

*"Report on the Season's Observations in Nebraska," published in the Report of the U. S. Department of Agriculture for 1887, p. 166.

†See Bibliographical notes following this article.

‡Since writing the above I have received from Mr. Shelby, in confirmation of the above, the following letter under date of November 30, 1888:—

"Chinch bugs appeared in Edwards county, seven miles north of Albion, in 1828, the year that General Andrew Jackson was first elected President of the United States, and the Whigs, in derision of the Democrats or Jackson men, dubbed them 'Jackson bugs.' I am not mistaken, as they almost destroyed a field of corn of my father's, the fodder from which the stock did not like to eat."

Mr. Shelly also writes, Dec. 12, 1888: "I have lately had a conversation with Mr. Elijah Nelson, who made a farm in 1820, two and a half miles west of where Olney now is, and he informs me that chinch bugs appeared in the first crop of oats that was sown on that farm, as early as 1823, and that his father told him that these were the same kind of bugs that they had in old Virginia. Mr. Nelson also tells me that in 1832 they appeared in considerable numbers and did some damage to corn. Mr. Nelson is a reliable old-time resident."

by the mere loss of sap, since the later growth of the corn, and especially that of the ear, must be dependent, in some measure, on these last-formed roots.

The negro bug associated with the chinch bug.—The negro bug (*Thyreocoris (Corimelaena) pulicarius*), extremely common in fields of wheat and grass with the chinch bug, is frequently held responsible by farmers for a part of the damage done to their crops, while by others it is looked upon as an enemy of the chinch bug. Careful observation at Ashley, June 14 to 16, where these bugs were extraordinarily numerous, failed to show them in any way injurious. They were seen only on weeds in the wheat fields and beside the road—usually the Spanish needle (*Bidens*) and plantain (*Plantago lanceolata*), and occasionally the common rag weed (*Ambrosia*). June 27, at Tonti, they were about half as numerous (in all stages except the very young) in our experimental plots of wheat as the chinch bugs themselves.

At Flora, in one meadow visited, heavily damaged by the chinch bug, the negro bugs were also excessively numerous, especially in the richer and more luxuriant parts of it. Hundreds might be seen on the ground at once by parting the grass and weeds. The timothy was not injured by them, but a common smart weed (*Polygonum persicarium*) seemed especially to attract them. Confined with this plant at the office, they were seen to feed upon it freely, piercing with their beaks both stems and leaves. Shut up for several days without plant food, but with chinch bugs, they paid no attention to the latter, but would walk across them without noticing their presence.

Chinch bugs breeding in oats.—Besides the instances already reported, the following may be noted, as occurring in a region where wheat, though scarce, was raised to some extent, and was not by any means wholly destroyed. On the farm of Mr. Alexander McMurray, near Tonti, in Marion county, I found June 27, 1888, chinch bugs of all ages below the adult generally distributed through oats a quarter of a mile from wheat—the grain reddening and falling in patches, here and there, as a result of this attack. They were nearly limited to the vicinity of dead furrows and to the lighter, poorer parts of the field. About five sixths of them were still in the red stages, the general advancement of development being clearly less than in the stubble of the recently harvested wheat. This fact was probably due to the later distribution of the old bugs in oats, as this crop was not yet sown when the chinch bugs began to fly in the spring.

In Effingham county, in 1887, many meadows and fields of oats were certainly destroyed by chinch bugs which bred in them from the beginning of the season; and corn adjacent was invaded from them in June and July, in the usual way.

Oviposition in midsummer.—At Ashley, June 14, 1887, I noticed that adults which had entered corn from wheat adjoining, were pairing freely, while nothing of the kind was seen in the ripened

wheat,—as yet uncut. Many adults being collected from each situation, and separately bottled, those from corn laid eggs in the bottle June 15, and those from wheat did not. Oviposition was but just beginning that year in Southern Illinois May 1; and as the interval between the laying of the egg and the appearance of the adult is fifty-five to sixty days (forty-five at the lowest estimate), the bugs breeding in corn June 14 were almost certainly individuals of the hibernating generation, which had not yet finished breeding when the ripening of the wheat warned them away to fresher fields. Those still remaining in the wheat were probably spent imagos, about to die. The number of very young in the corn mentioned made it seem quite probable that this invasion of the field by adults of the winter brood had begun some time before my visit. Eggs of this same brood were taken by Mr. Marten from the roots of nearly ripened wheat at Albion, June 13, 1888, brought to the office, and kept until they hatched.

July 24, 1888, I found at Centralia a few chinch bugs' eggs in corn behind the sheaths and even in longitudinal folds of the dead blades of the leaf, but could discover none on or about the roots. The imagos at this time were nearly all paired.

At Albion, August 1, 1888, eggs were found sparingly by Mr. Marten behind the sheaths of corn and rarely on the upper roots, but in immense numbers on the roots of an abundant grass-weed, *Panicum crus-galli*. On one stool of this plant were eighty-two eggs, and on another one hundred and seventy-seven,—some among the roots and others behind the sheathing bases of the leaves. August 24, eggs were found at Albion on roots of Hungarian grass, and on the stalks and blades of young wheat raised for experiment with the Hessian fly.

Sowing timothy with wheat.—Although timothy growing with wheat certainly will not always protect it, both crops, in extreme cases, yielding to the attack, that it will sometimes do so is shown by the following instance reported to me by Mr. E. E. Chester, of Champaign county, Illinois:—

A field of twenty-eight acres was sown to wheat in the fall of 1874, when the chinch bugs were innumerable throughout all this region, twenty acres with timothy and the remaining eight without, timothy being sown on the latter in the spring. This eight-acre plot, like the rest in every respect except that mentioned, was overwhelmingly infested by the chinch bug, the grain at harvest yielding only seven bushels per acre, while the twenty acres, bearing a thrifty growth of fall timothy, remained wholly unaffected except for a short distance adjoining the other plot, and yielded an average of twenty bushels to the acre. The latter wheat sold as "No. 1" at \$1 per bushel, and the former as "rejected" at 65 cents.

A similar observation is reported by Mr. J. A. Kelly, of Hazel Dell, Cumberland county, in a letter dated June 25, 1887, in which he says: "I accidentally discovered that by sowing timothy with

the wheat in fall, if it came up well, the bugs could not breed. On account of the dense shade formed by the timothy by the 10th of May, the eggs deposited on the wheat can not hatch."

Successful defence of corn.—Mr. Samuel Bartley, of Edgewood, Effingham county, to whose intelligent observations I have been several times indebted, writes me November 20, 1888, as follows:

"I am very confident that farmers can, by united effort, master the chinch bugs, or at least so check them that their damage to our crops will be slight. The most practical measure I have tried is ditching; and I am satisfied that we can protect ourselves in this way from damage by the chinch bug at very small expense

"Last year my neighbor had a forty-acre field of oats joining my corn. When he commenced cutting the oats, the chinch bugs commenced to travel toward my corn. I took a harrow and drag and ran a few times along the fence until the ground was quite dusty. I then took a small rail sharpened at the end and, shoving it before me, made two ditches about one foot apart. It was a surprise to me to see how few bugs reached the second ditch. In this way I kept them out of my field until a slight shower of rain fell, when a few got in before I renewed the ditches. As soon as they got on the corn, I applied the kerosene emulsion that you recommended, and it killed them instantly, not injuring the corn in the least. By these means I kept the bugs out of my corn until they got wings. I think now that if several ditches had been made in my neighbor's oats field after the grain was cut, the bugs could have been destroyed before they developed wings.

"Several neighbors tried the same plan this year with the same success I have reported."

Precaution in burning out chinch bugs in spring.—To destroy the old bugs by fire in their winter quarters is often difficult, because the rubbish protecting them will not burn close enough to the ground. Mr. Frederick Helms, of Heinrichstown, St. Clair county, has found that if care be used the chinch bug may be caught by burning after it has crawled out from its deeper retreat and before it is ready to take wing. He finds that there are a few days in spring during which the insect crawls about on the leaves and dead grass, not yet able or disposed to fly; and this is the time to be selected for burning over woods, headlands, and the like. Instances of protection to his crops by observance of this idea quite bear out his suggestion.

SUMMARY AND CONCLUSIONS.

From the observations and studies here reported, it appears that severe drouth in the middle and latter part of the summer may diminish the number of the chinch bug by lessening the food supply of the generations then breeding and hatching, and may operate also to protect the crops of the following year, at a dis-

tance from woodlands, by driving the adult chinch bugs from the open fields and compelling them to resort to the grassy woods for food for themselves and their young.

Severe drouth in a small-grain district has so thoroughly and so early destroyed the corn crop there, as to test practically the effect of abandoning that crop as a defence against the chinch bug. In the case observed, it was found that the injury the following season was very much less than before. As the drouth took effect, however, on the field grasses generally, and thus still further reduced the supply of insect food, the result was not to be attributed wholly to a lack of corn.

A similar destruction of the corn by drouth in midsummer followed by a general winter-killing of wheat, has shown that a successive abandonment of these crops may greatly reduce the numbers of the chinch bug, even where other conditions are very favorable to it, this reduction amounting, in one such case, to one-half or three fourths of the number abroad the year preceding.

Where wheat is abundant in a district very badly infested by chinch bugs, it is now certain that this insect may live and breed very successfully in early spring in oats, in young timothy and blue grass meadows, and even in corn.

A thorough-going investigation of the relations of chinch-bug injury to the acreage of the principal farm crops of Illinois in 1886 and 1887 shows that, where the outbreak was but just beginning, the wheat area had evidently much to do with the number and the rate of increase of the insects, a rising gradation of injury appearing in correspondence to an enlarging area in wheat, the acreage of the other crops at the same time remaining nearly constant or slightly declining. As the severity of the attack increases, however, the oats area begins to rise with the wheat, and may presently surpass the latter as a stimulus to the multiplication of the chinch bug, corn and grass finally showing a like tendency where it has become excessively abundant and destructive. Here, when the eggs of the winter brood are being laid freely on all the food plants of the species, the wheat area may even decline as one passes from districts where destruction is very great to those in which it is complete. This may be due to one or more of the following circumstances: (1.) The wheat area may be purposely diminished by the farmers, one year after another, as was certainly sometimes the case in southern Illinois in 1887, where chinch-bug injury had greatly lessened the yield and value of the crop for the season or two preceding; (2.) A change of feeding habits may arise among the insects themselves;* or (3.) there may be a spontaneous gradual shifting of the center of attack, due to a natural diminution in the number of insects one

*Such variations in choice of food under different conditions are not by any means rare among insects. The Hessian fly, for example, is very destructive to rye in Europe, while here it is almost never seen in that grain; and the chinch bug itself has made in New York a severe attack on meadows while not noticeably harming any cereal crop.

year in places where they were the year before the most abundant, and an increase in places where they were then less numerous. This territorial propagation outward from a center of first excess, accompanied by a diminution in numbers in the principal area of origin, has been fully described above; and a similar propagation from districts where the crop most preferred and first infested (wheat) is most abundant, to adjacent districts where the leading crops are those freely fed upon but less preferred, (oats, grass, etc.), is also highly probable, but less easily demonstrated. In both cases the diminution in numbers is doubtless largely due to the direct and indirect consequences of over-crowding,—a condition which always arouses or intensifies the action of the natural checks on excessive increase.

Further comparison of the crop areas of 1886 with the injuries of 1887 shows that a very decided diminution of the corn area has had little or no effect to diminish the loss to small grain the following year.

From the above we learn that the proper procedure respecting the grass and the cereal crops in the presence of a chinch-bug uprising is the prompt and early abandonment of wheat or a decided limitation of its area, to be followed presently, if the attack continues, by a diminution of the oats acreage also, and the sowing of clover, whenever practicable, instead of the grass forage plants. We also find that these measures must be taken early or not at all, since if too long postponed they may easily do more harm than good.

An analysis of the published opinions of economic entomologists shows a general and rather indiscriminate dependence on the abandonment of wheat culture as a defence against the chinch bug, this opinion being more positive, however, among the older entomologists than among those who have studied the question recently. It is a pleasure to find that the foregoing elaborate study necessitates little amendment of the recent statements and recommendations made from this office. A similar indiscriminate, but not unanimous, opinion as to the advantage of the abandonment of wheat appears in the statements of 200 agricultural correspondents of the office, 87 per cent. of the replies to an inquiry touching this matter being in the affirmative.

From the miscellaneous experiments here reported, it appears that the worst infested fields of small grain may be sustained under a chinch bug attack by heavy fertilization, if the land be originally in good condition; and that, in general, the damage done will vary inversely to the fertility of the soil and the support given by fertilizers to the crop attacked. The best fertilizers for this purpose on the wheat lands of the central part of Southern Illinois, seem to be, first, barn-yard manure, and, second, the phosphates and nitrates combined.

The kerosene emulsion, whose deadly effect on the chinch bug was first shown by me in 1882, has repeatedly proven a very valuable agent in the hands of farmers when applied in the field for

the protection of corn; but it may best be used in combination with some obstruction to the passage of the chinch bug from small grain and grass to corn,—either ditches and furrows, as described above, or belts of coal-tar along the border of the field. A mixture of coal-tar with oil or grease, ten parts to one, will last without hardening in the sun, from five to ten times as long as the pure tar, but is too fluid to be poured directly on the ground.

Tobacco water was found frequently fatal to chinch bugs of all ages, but was apparently less effective than the kerosene emulsion. An emulsion of coal-tar likewise gave promise of usefulness, having the advantage in cost over the kerosene mixture, but being somewhat less convenient of application.

On the other hand, infusion of lobelia, coal-tar water, turpentine emulsion, lime-water, fresh gas-lime, arsenic, London purple, Paris green, the "Egyptian insecticide," buhach, corrosive sublimate, and steam, were applied to chinch bugs with discouraging results.

Some starvation experiments not begun until September 4, were unsatisfactory because of the lateness of the period, and because most of the bugs from the district where the specimens used in our experiments were collected, proved to be already weakened by disease. Adults and young,—some just hatched,—confined on a dry surface and without food, died in from one to six days. Other young, taken as they hatched, lived from twelve to twenty-four hours.

Careful studies of the contagious diseases of chinch bugs, revealed in August and September, 1888, the presence of three distinct forms of fungous disease, two of them identical with those reported by me in 1882, and the third new. All these were widely distributed through Southern Illinois, with the possible exception of the region bordering the Ohio River.

Two of these diseases are produced by thread fungi (*Entomophthora* and *Botrytis*) which make a rapid external growth after the death of the insect, presently imbedding the body in a snow-white mold; and the third is a bacterial disease, characterized by a minute bacillus which has its principal seat in the cœca (not the Malpighian tubules) of the alimentary canal. Many and various culture experiments with the latter were completely successful; but infection experiments could not be made for want of specimens originally free from disease. On the other hand, culture experiments with the *Entomophthora* and *Botrytis* were tried without success.

Among various miscellaneous notes, I have reported the failure of an attempt to force the chinch bug to feed on wild buckwheat (*Polygonum dumetorum*); the very early occurrence of the chinch bug in Edwards county, Illinois, (in 1823, and again in 1828); the prostration of wheat and corn as an effect of chinch-bug injury (due to failure of development of the latest circle of "brace

roots;" the harmlessness and uselessness of the flea negro bug, often found associated with the chinch bug in wheat; the place and time of deposition of the eggs for the second brood; the protective value, under certain certain circumstances, of the sowing of timothy with wheat in fall; the successful defense of a corn field by plowing and ditching against an invasion from small grain; and an important modification of the mode of destruction by burning in spring.

THE CORN-BILL BUGS.

(SPHENOPHORUS SP.)

FAMILY *Calandridæ*. ORDER *Coleoptera*.

(Plates I., II., and III.)

The snout beetles of the genus *Sphenophorus* (popularly known to some extent as "bill bugs") are gradually rising to prominence as injurious insects,—corn especially suffering from them a serious and often fatal injury which has long been known although but little understood; and as the life histories and habits of the various species are apparently very similar, others than those now known to injure agricultural products will probably be added to the list of noxious species. The essential facts concerning none of these beetles are yet known in full, and a summary of existing knowledge, new and old, which shall serve as a guide to further observation, is undoubtedly a *desideratum*.

The crops certainly more or less subject to the attacks of these beetles are corn, wheat, oats, rye, timothy, and millet; and the species found addicted to these injuries are eight in number; viz., *pertinax*, *robustus*, *parvulus*, *cariosus*, and *sculptilis*, previously reported, and *ochreus*,* *placidus*, and *scoparius*, whose habits are here for the first time described in entomological literature.

* An item to the following effect appeared in various leading newspapers of the Mississippi Valley, and in some eastern publications, in June and July, 1888:

"The State Entomologist, Prof. S. A. Forbes, reports that he has discovered in the swamp lands now being rapidly drained and brought under cultivation, a destructive attack on corn by a native insect not before recognized as injurious,—one of the snout beetles or "bill bugs" (*Sphenophorus ochreus*), of whose habits or history nothing has been hitherto ascertained.

It now appears, however, that this insect feeds commonly on a large club rush (*Scirpus fluviatilis*) and the common reed (*Phragmites communis*),—plants which grow abundantly in the lowest marshy prairies,—and attacks corn when planted on ground where these grasses have been plowed up.

The beetle is about half an inch long, clay-colored, and bears a long snout or proboscis, at the end of which is a pair of minute jaws. This snout it thrusts into the stalk of corn or stem of grass upon which it is feeding, chewing and swallowing the soft internal tissues of the plant. Whole fields of corn have thus been destroyed two or three times in succession. The injury has not yet ceased, as the beetles are but just preparing to breed, and farmers have consequently been compelled to abandon their corn and sow the ground to some later crop—such as millet or flax—supposed not to be liable to injury by this beetle.

The habits of other beetles of its kind indicate that this species may succeed in breeding in the stalks of corn, in which case it is liable to spread from its present limited localities to corn fields at large. It should receive, consequently, the closest and most intelligent attention of entomologists and farmers. It has not yet been found seriously affecting corn the second year after grass, and its worst injuries can consequently be prevented by planting ground bearing reeds and large rushes, for the first year, to some other crop than corn."

All the above are injurious to corn, only *parvulus* affecting small grain and timothy also, and *ochreus* attacking both corn and millet. All damage corn in the same way, piercing the young plant in early spring with their beaks, and chewing and devouring the soft interior tissue. This gives rise to an appearance, as the leaves unfold, of parallel oblong holes extending across the leaf, due to the fact that the young leaf has been several times punctured by one thrust of the insect's beak. Where the injury is severe, the growing tip of the plant is killed, or the stalk is dwarfed and does not mature the ear, or the whole plant is killed outright.

ANALYSIS OF LITERATURE.*

Under this head I give, for the benefit of those who do not have access to the literature of economic entomology, an analytical synopsis of published matter relating to the species of *Sphenophorus* occurring in Illinois in numbers sufficient to make their known or probable injuries a matter of importance.

The Genus Sphenophorus. This genus, first distinguished and described in 1837 by Schönherr (5-874), was restricted by Dr. Horn, in 1873, by the removal of *Metamasius* (23-411); and again by LeConte in 1876 by the separation of *Rhodobæus* and *Cactophagus* (28-331). It was last described in 1883 by LeConte and Horn in their "Classification of North American Coleoptera" (47), where its distinctive characters and distribution are given.

Besides the general mention of the species in the catalogues and check lists of the Coleoptera of North America (7, 22, 37, 52), record of the Kansas species was made by Popenoe and by Snow in 1876 (26, 27); of the Florida species by Schwarz (31), and of those of Michigan by Hubbard and Schwarz in 1878 (32-642, 665); of those of Cincinnati and vicinity by Dury in 1879 (33); and of the species of Ottawa, Canada, by Harrington in 1884 (49).

Townsend Glover (United States Entomologist) made, in 1854 (8), the first mention of the genus as injurious to crops, describing an injury to corn in South Carolina, Alabama, and Arkansas by some undetermined species (probably *robustus*). He records the appearance of the beetle in spring, the place of deposition of the egg, the habits and place of pupation of the larva, and the nature and amount of injury to corn,—most serious on swamp lands. Their numbers were apparently diminished by plowing up and burning stubble and roots of corn. This article was afterwards abstracted by Lintner in his First Report as State Entomologist of New York (46-260), and by Riley in the "American Naturalist" (41). In 1863 (14) Glover adds the suggestion of hand picking as a practical remedy.

S. ochreus, Lec. (The Clay-colored Bill Bug). This species but recently known as injurious, has not been mentioned hitherto

* Figures in parenthesis refer to bibliography at close of article.

in economic literature. It was first described in 1858 (12) by LeConte; and at greater length in 1873 by Dr. Horn (23-416), who surmises that the name may prove to be a synonym of Gyllenhal's *S. equalis*.

The only notice of its injury to crops is one published by myself in July, 1888, in the agricultural and daily press of Illinois, giving a brief account of its life history so far as known, of its native haunts and food plants, and of its injuries to corn.*

S. pertinax, Oliv. This species, known as a corn insect since 1873, first described by Olivier (1-83, 90), was described again by Say as *interstitialis*, in 1831 (4-288); and finally in 1873 by Horn (23-418), who also gives the synonymy and mentions its injuries to corn. Its destruction of young corn on low land in the South was reported by Comstock in 1881 (39)†. Quick lime, land plaster, and guano were found without effect. Adults are said to hibernate in the tap roots of the corn, where they can be destroyed by plowing up and burning the stubble. The beetles were not affected by six days' overflow.

Prof. Kellicott has bred this species from larvæ infesting the common "cat-tail" flag, *Typha latifolia* (44).

S. pertinax was mentioned by Dr. Riley in 1882 (45-141) as a well known enemy to corn; and in 1884 its occurrence on the New Jersey coast was recorded by Dr. John Hamilton (50).

In 1886 Mr. T. F. Hunt gave a partial bibliography of the species as a corn insect (55-108); and Mr. Webster briefly summarized the facts concerning its injuries to corn in the Southern States (58).

S. robustus, Horn. This "bill bug," described in 1873 (23-419), was found by Comstock responsible for a serious injury to corn in Alabama in 1880 (see under *pertinax*),—a fact reiterated in 1881 and 1882 by Riley (41, 45-139), who also gave an illustrated account of its life history, described larva, pupa, and adult, and recommended as preventive measures, dusting with arsenical poisons, and plowing up and burning the corn stubble.

It was further briefly treated by Riley in 1884 (51), and by Hunt (55-109) and Webster (58) in 1885.

S. cariosus, Oliv. Although the technical record of this species is long and involved, its economic literature is limited to a single item,—a report by Glover, in 1871 (20), of its injuries as larva and adult to corn in New Jersey.

It has been described by Olivier as *cariosa* and *callosa*, by Germar as *larvalis*, by Say as *cicatricosus*, and by Gyllenhal as *cariosus*, *flexuosus*, n. sp., *cicatricosus*, and *callosus*. Its synonymy is given by Horn (23-420) and by LeConte (28-425),—its best description by Horn,—and a partial bibliography by Hunt (55-109).

*See foot-note page 58.

†Dr. Riley, into whose hands Prof. Comstock's specimens seem to have come, considers them to belong to the very similar species *robustus*.

S. sculptilis, Uhler. This species, described by Uhler (9) in 1855, was first mentioned in that year, under the name of *S. venatus*, Say, as an enemy to corn in New York by Dr. Fitch (10), who described the adult, reported it common in meadows, groves, and gardens, and suggested hand picking and the application of lime as remedies for its injuries.

In 1860 (13) it was mentioned by Mr. Geddes, of New York, as a new enemy to corn.

Next, it was described by Walsh in 1867 as *S. zeæ* (17), on the supposition that it had not been previously recognized. Its occurrence in Rock Island and on the Lake beach at Chicago is recorded and its receipt reported from Pennsylvania and New York, its injuries to corn in these states being also described. Walsh ventures the surmise that the larva lives in moist decaying wood, and suggests that the beetles may be distributed in swamp muck. He considers it likely that the adult will be found injurious to corn only where large accumulations of driftwood occur.

We find it also referred to in the "Prairie Farmer" for 1867 (Vol. XX., p. 21) under the name *S. antiqua*, with a record of its first supposed appearance in New York (quoted from the "Rural New Yorker") in 1866, and a report that it had been very troublesome in corn in 1867.

In the following year (1868) Dr. Cyrus Thomas speaks of it in the "Prairie Farmer," page 26, as injurious to grass and corn, and repeats Walsh's surmise with respect to its breeding in rotten wood.

Still under the name of *S. zeæ*, Dr. Riley treats it in 1871 (21), reprints Walsh's description of the adult, gives the history and method of its attack, and speaks of its larval history as unknown.

In 1873 Dr. Horn describes it in his monograph of the genus (23-424) under its original name of *sculptilis*, and also under that of *zeæ*, the identity of the two forms not having yet been recognized.

In 1875 Dr. Packard speaks of it briefly (25), describes the adult, mentions its occurrence in New York and Massachusetts, and recommends hand picking.

In 1876 (28-425), Dr. LeConte unites *zeæ* with *sculptilis*, but in 1877, Dr. C. Thomas, then State Entomologist of Illinois, refers to it briefly in his Sixth Report (29), still under the name of *S. zeæ*, Walsh.; describes the adult; and speaks of its injuries to corn. This matter is repeated in substantially the same terms in his next Report (30).

In 1879, Lintner gives the synonymy of this species, speaks of its extensive distribution, and describes the adult (34-46). He mentions especially its injuries in New Jersey, and gives a synopsis of its past history.

In 1880 Prof. Comstock, Entomologist of the United States Department of Agriculture, treats this species (36), still under the name of *zeæ*, speaks of its injuries to corn in Missouri, on dry

land not near water, and of its appearance in corn on clover sod; and Mr. O. Lugger, (38), speaking of it as *S. zeæ*, reports its injuries to corn in Maryland, describes the adult, and gives some account of the habits of allied species.

In 1881 Prof. Comstock (39) reports this species as extremely injurious to corn in South Carolina,—now referring to it under its proper name; and Riley (42) again corrects the synonymy, and identifies it with *sculptilis*,—as LeConte had already done some years before. In the "American Naturalist" (41) he describes its injuries to corn, speaks of its distribution, and discusses the theory of its origin in decaying driftwood,—this article being reprinted the following year in his Report as Entomologist to the U. S. Department of Agriculture (45-139).

Next, in 1882, this species received exhaustive treatment from the hands of Dr. Lintner (46-253), his discussion including its bibliography, synonymy, a description of the adult, and a *résumé* of its injuries to corn. He surmises that the larva feeds upon some wild grass,—and perhaps also on corn; gives the food and habits of allied species; mentions certain *Sphenophorus* larvæ known to occur in corn; and suggests as remedies the application of kerosene oil mixed with sand, and plowing up and burning the stubble of the corn in fall for the purpose of destroying the hibernating beetles.

The following year Dr. Lintner speaks of the "frenching" of corn as due largely to snout beetles,—probably to this species,—and repeats the essential facts ascertained with regard to its distribution and life history, remedies for its injuries, etc. (48, 53-16).

In 1884 Dr. Riley mentions the destruction by this beetle of corn on timothy sod in Iowa (51).

In 1885 (53-52), Lintner gives additional notes on its past history in N. Y.; and in 1886 Mr. T. F. Hunt (55-109) gives a partial bibliography of the species as a corn insect, and mentions its occurrence in a single instance in a mass of eaten bulbs of timothy.

In 1888 (60), Mr. Webster reports the finding of adults puncturing corn just below the surface of the ground, and describes the resultant injury to the leaves.

S. scoparius, Horn. This species, published as new in 1873 (23-424), has been mentioned since only in general and local lists of species. Its occurrence as a corn insect in Illinois will be established on another page.

S. placidus, Say. The literature of this species is almost purely technical, a single item by Hamilton (50) with respect to its occurrence under driftwood in meadows being the only other reference I have seen. It was described in 1831 (4 290), and its synonymy was given by Horn in 1873 (23-326). It is here introduced because found infesting corn in Illinois.

S. parvulus, Gyll. This, the smallest of our Sphenophori hitherto known, was described by Gyllenhal in 1837 (5-961), and by Horn in 1873 (23-427), but was not noticed as an injurious insect until 1882, when Riley received it from corn fields in Missouri (45-139). In 1885 I bred the beetle from larvæ devouring the bulbs of timothy (56), and found the imago injuring both corn and wheat. Mr. Webster also found it in barley, oats, and corn; bred it from larvæ infesting rye; and obtained larvæ and eggs from wheat (54, 58). It transforms in August and hibernates under rubbish. In 1886 Hunt published its economic bibliography (55-111), and in 1887 (59), Webster reported its occurrence in bulbs of timothy.

DESCRIPTION.

THE GENUS SPHENOPHORUS. From other snout beetles the genus *Sphenophorus* may be distinguished by the following list of characters abstracted from those of the family and genus as given in the "Classification of the Coleoptera of North America," by Le Conte and Horn:

Elytra without epipleuræ, but with a strong fold on the inner surface; the pygidium normal, uncovered, undivided in both sexes. The tibiæ are not serrate; the antennæ are geniculate, inserted near the base of the beak; the labrum is wanting; the last spiracle is not visible. The head is carried horizontally, the beak never narrowed behind the eyes, and at most capable of being brought down to a vertical position. First abdominal suture nearly obliterated at the middle. The side pieces of the metathorax not very wide, those in the mesothorax broadly truncate externally, so that the outline of the elytra near the base is straight. The spongy part of the antennal club is convex; the anterior coxæ are but narrowly separated; the tarsi have the third joint glabrous or pilose at the sides, and the body is glabrous beneath.

The characters of the species with which we are concerned may be best shown by an analytical synopsis.

KEY TO ILLINOIS SPECIES.*

(See Plates I-III.)

- 1 (2). Hind tarsi with third joint broadly dilated, spongy pubescent beneath except at middle. Black, with clay-colored natural coating; thorax trivittate, branch of lateral vittæ short or wanting; elytral intervals flat, alternately broader; size large (13-18 mm.). Can. to Ariz.....*ochreus*.
- 2 (1). Hind tarsi with third joint slightly or not at all dilated, beneath merely fringed at sides, or smooth.
- 3 (18). Lateral thoracic vittæ present.

*Prepared by Mr. C. A. Hart.

- 4 (17). Median vitta entire in front, not forked.
- 5 (15, 16). Lateral vittæ with distinct branch exteriorly.
- 6 (11). Punctures of elytral striæ moderate or fine; thoracic vittæ continuous, their outline distinct.
- 7 (10). Vittæ irregular in outline, not strongly elevated; punctures of elytral striæ rather fine.
- 8 (9). Elytral intervals feebly alternating in width and convexity, the narrower intervals and thoracic interspaces with a luteous coating; length 11-14 mm. U. S., Can.....*pertinax*.
- 9 (8). Elytral intervals flat, equal, usually uniformly coated, thoracic vittæ in one variety tending to obliteration; length 11-14 mm. U. S.....*robustus*.
- 10 (7). Vittæ strongly elevated, parallel, entire; punctures of elytral striæ moderate, the intervals alternating in width, the broader strongly convex; surface with luteous coating as in *pertinax*; length 10-11 mm. Ga., Ill., Wis., Nev., Mich., Kan.....*costipennis*.
- 11 (6). Punctures of elytral striæ coarse, lateral vittæ more or less interrupted or obscure just in front of origin of branch, outline of vittæ confused by very coarse punctures of interspaces.
- 12 (13, 14). Hind tibiæ of male strongly angulate, angle with dense brush of long hair; elytral intervals alternating, the broader and more convex biserially punctulate, the others uniserially, striæ with coarse punctures; median vitta entire; length 9-12 mm. Ill., Wis., Kan.....*scoparius*.
- 13 (12, 14). Male tibiæ normal, elytral intervals subequal, striæ, with very coarse foveæ; interruption of lateral vittæ conspicuous, the interspaces with coarse subconfluent foveæ; median vitta entire; length 8-9 mm. Middle, Western, and Southern States, Can.....*sculptilis*.
- 14 (12, 13). Male tibiæ normal, elytra angulate-carinate at third elytral interval, especially on basal half; median vitta not reaching base of thorax, a small callus near anterior angles, punctures foveolate; elytral surface uneven, striæ with foveolate punctures; surface usually with uniform brownish or olivaceous coating; length 8-12 mm. Middle, Western, and Gulf States*cariosus*.
- 15 (5, 16). Lateral vittæ vaguely indicated, branch obsolete, median represented by a short carina beginning at apex and ending in a smooth, usually denuded, rhomboid spot near middle; a small callus near anterior angles; elytral surface uneven, striæ moderately coarsely punctate, surface with brownish coating; length 7.5-10 mm. Ga. to Mich., Ill., and Kan.....*melanocephalus*.

- 16 (5, 15). Lateral vittæ without branch, becoming indistinct or obsolete in front of middle of thorax, median distinct; elytral intervals subequal, punctulate; size small (6.5 mm.). Penn., Ga., Ill., Oregon *sayi*.
- 17 (4). Median vitta forked in front, branches curving outward and often joining tip of laterals, lateral branch feeble or wanting; elytral intervals alternating, the broader and more convex biserially, the others uniserially punctate; size small to medium (6-10 mm.). U. S. *placidus*.
- 18 (3). Lateral vittæ entirely absent.
- 19 (20). Thorax broadest in front of middle, with very coarse variolate punctures sparsely and irregularly placed, sometimes a short, narrow tubercle near middle, occasionally extending posteriorly as an obsolete raised line; elytral surface uneven, striæ with very coarse variolate punctures forming irregular transverse rows, intervals flat, uneven, especially the 6th and 7th, uniserially and finely punctulate; entire surface usually with uniform coating; size small (5-6 mm.). Urbana and Springfield, Ill. *minimus*.*
- 20 (19). Thorax broadest behind the middle, regularly rounded, uniformly, densely, and moderately coarsely punctate, sometimes a fine smooth median line; elytra evenly rounded, striæ with coarse punctures, intervals flat, with a single row of less coarse punctures; surface with argillaceous coating, the narrow spaces between the thoracic punctures usually denuded; size small (6-7 mm.). Penn., Ga., Fla., Ind., Ill., Mo., Kan. *parvulus*.

IMMATURE STAGES.

The only species hitherto sufficiently described in its immature stages is *robustus*,—a species so infrequent in Illinois that Riley's elaborate description (46-141) need not be here repeated.

**Sphenophorus minimus*, n. sp. Surface opaque black, covered with uniform pale ochreous or cinereous coating, except the rostrum in front of the insertion of the antennæ, the anterior surface of the fore femora at base, the knees, the tips of the tibiæ, some of the sternal sutures, a spot at the middle of the abdomen on the second, or first and second, ventral segments, and the antennal club, which are shining black, the latter spongy pubescent at tip as usual; and the tarsi and funicle of antennæ, which are shining brown.

Rostrum two thirds as long as thorax, moderately stout, slightly compressed, curved, tip not dilated, base punctulate, broadly canalliculate, sub-carinate each side of the sulcus, suddenly and strongly dilated over the scrobes.

Thorax longer than wide, nearly as wide as the elytra, broadest in front of middle, widening back of the apical constriction, at first very rapidly, then more slowly, to a point in front of middle: from this to base slightly narrowing, sides nearly straight, base oblique each side of middle; surface sparsely, coarsely, and irregularly foveate-punctate, a very small oblong tubercle, usually denuded and shining, in front of middle, from which an obsolete smooth narrow median line sometimes extends posteriorly, but does not reach the base. Scutellum oblong, flat, usually coated.

Elytra broadest behind the base, narrowing strongly to apex; striæ fine, with coarse foveate punctures depressing the surrounding space and forming irregular transverse rows, making the surface very uneven, especially on the sixth and seventh intervals; intervals flat, subequal, finely uniserially punctulate, the third, in some specimens, slightly elevated; subapical callus elevated into a distinct tubercle with the posterior outline nearly vertical. Pygidium punctate, with a minute ferruginous tuft of hair at each posterior angle. Beneath uniformly, not very densely, coarsely punctate, less coarsely on prosternum; femora and tibiae strongly punctate. Length 5-6 mm. Described from six males and five females, from floating driftwood, and logs near water, at Urbana and Springfield, Ill. The elytral surface of this species recalls *cariosus*. It is the smallest in our fauna.

S. ochreus? Larva. Under this name I describe, with great misgiving as to its species, a larva found July 28, 1888, in a cavity eaten in a bulb of the club rush (*Phragmites*), where the adult *Sphenophorus ochreus* was very abundant, doing great injury to corn and millet.—A thick, footless grub about 12 mm. long by 5 mm. broad, white, except the head and cervical shield; the former chestnut-brown, blackening to the clypeus, which is paler than either front or labrum. Occiput marked with two pale vittæ, which meet posteriorly, forming there an indefinite pale patch, and diverge toward the mandibles, extending as far as the frontal suture. These vittæ bordered externally at base by a short dash of black. A similar short dash upon each side of the base of the head, usually concealed by the first segment of the body. No lateral pale vittæ as in *robustus*. Mandibles black; other mouth parts brown.

Head regularly oval, the sides not angular. Occiput with a shallow median channel, linear behind, but deepening and broadening to the frontal suture, beyond which it becomes a still deeper irregular three-lobed impression, and then continues for a little distance on the front as an indistinct slight line. A rather large distinct vertical frontal impression on either side of the terminal portion of this line, extending into the conspicuously corrugated frontal area. Front with a curved transverse row of four bristles, the lateral ones at its anterior margins, two additional bristles above these, near the frontal suture. Corrugations of the front transverse, interrupted by irregular smooth patches. Sides of front with indistinct vertical ridge or obtuse angle just within base of mandibles. Occipital vitta with two bristle-bearing punctures, one at its lower end and one at its lower third, these connected by a delicate impressed line. Another broken impressed line, somewhat parallel to the above, at a little distance outside it, connects three bristle-bearing punctures upon the occiput, the lower one of these with a distinct smooth puncture between it and the frontal suture.

Clypeus free, smooth, elevated in front, its anterior and posterior margins nearly straight, the latter with two short stout bristles at each side, near the angle. Labrum irregularly impressed with two vertical grooves, and an obscure transverse connecting groove forming a broad letter H. Bears six bristles on the exposed surface, four in a transverse row, and two on the anterior margin. Frontal suture obtusely rounded at apex, distinctly sinuate between this and the point of contact with the frontal vitta.

Antennæ rudimentary and very minute, at extreme frontal margin, just within end of frontal suture, at base of mandible, borne at the end of the shining curved tubercle. But one ocellus at edge of front, separated from antenna by frontal suture. Mandible entire at the tip, grooved at base, external groove with a single bristle, outer surface above the groove less distinctly so. Cardo small, wedge-shaped, stipes large, with a large and deep excavation beneath. Maxillary palpi three-jointed; basal joint wide as long, second joint longer than wide, narrowed distally, about half as

wide as the first and a little longer than the last, this about two thirds the width of the second. Mentum deeply emarginate, with acute lobes, very deeply bisulcate longitudinally. Median lobe transversely corrugate. Lateral lobes with a short basal piece abutting against the cardo of the maxilla. Lateral lobes with a stout bristle at the anterior third; middle lobe with a smaller pair of bristles opposite apex of emargination. Palpiger with a deep median sulcus, each side lobe bearing a stout bristle. Palpi two-jointed, joints ovate, similar. Ligula rounded, curved upward at tip, a pair of stout bristles beneath, but otherwise smooth.

Cervical shield pale brown, with a darker transverse line. Spiracles nine, first and last especially large; all of them patent. Tip of abdomen flattened or slightly concave on its dorsal surface, provided there with strong bristles, eight of which are borne by the last segment in two rows, and four in a single row by the preceding segment.

S. parvulus. *Larva*. About 6 mm. long by 2.5 in width. Except for size, extremely like *S. ochreus*. Head much paler,—dull yellowish brown; clypeus yellowish; labrum concolorous with the occiput. Latter with diverging frontal vittæ, less closely approximate than in *ochreus*, forming a larger pale patch posteriorly. Sides of head beneath with an obscure pale longitudinal stripe. Frontal suture less sinuate than in *ochreus*; its angle more acute. Frontal corrugations less conspicuous. Occipital black dashes not bordering the vitta externally.

DISTRIBUTION.

The general distribution of these species has been sufficiently indicated in the preceding synopsis; and concerning their occurrence in this State, I need only say that all those treated in the present paper have been collected by us frequently in Central Illinois with the exception of *robustus*, which is rare in our collections and has come to us only from the northern part of the State. *S. pertinax* was taken by us also in Cook county near Lake Michigan; *cariosus* near Cairo and in Champaign county; and *sculptilis* at Villa Ridge, in extreme Southern Illinois. *Placidus* was obtained also in the northern part of the State,—from Lake and Whiteside counties.

LIFE HISTORIES.

The life histories of only six of our North American species are even approximately known,—that of *parvulus* most fully, and those of *ochreus*, *pertinax*, *robustus* and *costipennis*, by detached observations,—*ochreus*, *pertinax*, and *costipennis* being here first reported.

Parvulus is certainly single-brooded, is known to hibernate as an imago, appearing in spring as early as March and April* and

*This species was found by us not uncommon under dead vegetation in meadows, evidently still in winter quarters, April 16, 1887, at Edgewood, Ill. Occasionally a timothy bulb hollowed out by the larva was noticed in this field.

occurring also in that stage in May, June, and July. It has been seen to lay eggs July 1; occurs in the larval stage certainly from June 11 to July 21; has pupated by July 24; and has emerged as an adult from August 11 to October 5.

Robustus has also been seen abroad as an imago in early spring. Larvæ of various ages and pupæ were collected in South Carolina August 20, and a single adult emerged a few days later.

We have obtained the imagos of *S. ochreus* in May, June, and July, and have found them living as late as August 1. The sexes pair certainly by the 20th of June, and eggs have been laid on the 30th of July, full-sized larvæ and others partly grown also occurring at that time.

In nature this species breeds in the large dense root-bulbs of the common club rush, *Scirpus fluviatilis*,—a coarse grass-like plant extremely abundant in the lowest marshy prairies. Whether pupation occurs in the cavity of the bulb or in the earth adjacent is not yet certain, although the fact that a dead beetle was found by us within a larval burrow where it had evidently perished after transforming, is evidence that the larva does not desert the bulb before pupation.

Elaborate experiments made at the office and on the University farm, failed to show that this beetle could breed in corn. Hills of corn with which imagos had for several weeks been enclosed and upon which they fed with the greatest freedom, were not infested by the larvæ of this species, neither could eggs be found about or upon them, although the beetles were pairing when imprisoned.

Pertinax has been found abroad as an imago in early spring, making its attack upon the young corn. It was bred by Dr. Kellicott,* as I am informed by a recent letter from him, in July and August of three successive years (1880-1882).† In our own collections the imago of this species has been taken only in July.

The above are the only species whose immature stages have been observed, but dates of occurrence and time of attack of the imagos of other species of the genus indicate for them very similar, if not identical, life histories. *Cariosus*‡ has been collected by us from June 4 to July 1, and again September 16. *Sculptilis* has likewise occurred in June, July, and September. *Scoparius* we have found on corn and grass from June 16 to July 7; and *placidus* from May 20 to August 5, the latter date from northern Illinois.

*Concerning this species, Dr. Kellicott writes me: "It is abundant at Buffalo. The larva cuts an oblique burrow in the base of the plant and pupates in the same."

†Dr. Kellicott also informs me that he bred *costipennis* in July 1881, from the club rush, *Scirpus lacustris*.

‡Since the above was written we have repeatedly bred *cariosus* from eggs deposited in perforations made in the lower part of a common sedge, *Cyperus strigosus*.

INJURIES TO VEGETATION.

As larvæ these species live and feed, as far as known, in the roots of grass-like plants, less commonly boring also the lower part of the stem. Grasses with bulbous roots, like timothy and the club rush, are probably their more normal breeding plants. In timothy meadows the hollowing out of the root bulb frequently kills the plant,—if not outright, then the following year. The larger club rush seems to endure better the attack of the clay-colored bill bug, as several successive bulbs of a series are often found excavated, each having given origin to its plant notwithstanding the injury.

The natural food of the *robustus* larva is unknown, as this has been found feeding only in corn. "Wherever," says Mr. Howard, "the larva has reached its full size, the pith of the stalk was found completely eaten out for at least five inches. Below ground even the hard, external portions of the stalk were eaten through, and in one instance everything except the rootlets had disappeared, and the stalk had fallen to the ground."

"In a great majority of instances but a single larva was found in a stalk, but a few cases were found where two larvæ were at work. In no case had an ear filled on a stalk bored by this larva. The stalk was often stunted and twisted, and the lower leaves were invariably brown and withered."

The larva of *parvulus* eats into the grass bulb, commonly from beneath, completely hollowing it out, and scattering a fine meal-like excrement through the earth. The harm thus done is sometimes considerable,—five per cent. or more of the stems being deadened,—but has never been severe, as far as I now know. In small grain, according to Mr. Webster, *parvulus* hollows out the stem between the first and second joints above the ground, and in corn, burrows in the lower part of the stalk. A small *Sphenophorus* larva found occasionally in the lower part of wheat stems in June, 1887, by my assistant Mr. Weed, belongs to this species.

The natural food of the adult *ochreus* is, at first, the club rush, in whose roots the larva breeds, as was shown in the swamps of Ford county by the very general and profuse perforation of the leaves of this rush where the beetles were themselves abundant. By the end of June, however, this plant had become too hard for them, and then the beetles were seen feeding in numbers on the terminal leaves and forming spray of blossoms of the common reed (*Phragmites communis*), which were rolled together in an oblong mass at the tip of the stalk. This they were piercing and splitting lengthwise, afterward eating out the succulent young vegetation from within.

The adults of all the species feed in substantially the same manner, as far as observed, and inflict a similar injury on the plants they infest. Standing with the head downward and the feet embracing the lower part of the stalk, they slowly sink the beak into the plant, using the jaws to make the necessary perforation.

At intervals the head is slowly and regularly rolled from side to side as if to pry apart the severed tissue, and when the soft interior substance of the plant is penetrated a pause is made to enable the insect to devour the part thus brought within reach of its jaws. By moving forward and backward and twisting to the right and left, the beetle will often hollow out a cavity beneath the surface much larger than the superficial injury would indicate. *Ochreus* (and possibly other species also) elongates the original slit by pulling the head strongly backward with the compressed beak inserted, thus using the latter to split the stem as a boy uses his knife to split a stick. In this way a slit an inch long may be made in the stalk of corn or head of cane, beneath which the softer parts will be completely eaten out. Our imprisoned beetles, confined with rapidly growing corn, left the lower part of the stalk, as it hardened, and fed at the tip of the plant, or searched out the forming ear, penetrated the husk, and gouged out the substance of the soft cob. The intestines of these beetles were well filled with the solid tissue of the plant, but I saw no evidence that they also suck the sap, although it is not, perhaps, impossible.*

The effect on the corn plant of such injuries as the above varies according to the size of the species and the number of the beetles. A small species may do little more than to leave a trace of its visit in the form of a series or two of oblong parallel holes across one or more of the leaves, each row resulting from a single thrust of the beak when the leaves were closely rolled together around the stem of the young plant; but the larger species, especially if several individuals attack the same plant, may completely kill the corn or grass, or so rag and deform the young leaves that no ear is matured.

In Ford county, near Piper City, where the first crops were being raised after the draining of the swamps, I found, late in June, several fields which were finally being plowed up after two or three times replanting; and even the millet sown after corn was attacked, in some places not more than twenty per cent. of a yield maturing. The perforation of so small a stem by so large a beetle cut the plant off within the sheath and killed it outright. Fox-tail grass (*Setaria*) was injured in the same manner.

S. scoparius is included among the probable enemies to corn on the strength of an observation made by an assistant, Mr. H. Garman, who found this beetle under ground, at the base of a stalk of corn in Logan county, June 16, 1885.

S. placidus was repeatedly taken from stalks of corn, just beneath the surface of the ground, by another assistant, Mr. John Marten, July 7, 1888, and was also sent to me by Mr. Joseph Carter, from Rankin, Illinois, with the following letter, dated March 31, 1887:

*See Rep. U. S. Ent., 1882, p. 139; and Rep. St. Ent. N. Y., 1882, p. 254.

"Enclosed is a bug, found on corn plant below surface of ground. Eats into plant when leaf appears above ground. Leaf crossed by parallel rows of holes. Find beetles on every plant on an acre or two of corn planted on fall plowing where oats grew last year. Looks as if they were about to destroy the corn entirely. Ground dry, sandy, and tiled every 100 feet."

In a subsequent letter Mr. Carter informed me that some five to ten acres of his corn was being destroyed by these beetles.

S. cariosus, reported by Glover as injurious in New Jersey, was received by me, June 4, 1888, from South Carolina, through Mr. B. F. Johnson, of Champaign, with the information that it was very destructive to corn in that State. Every one of about fifty specimens collected from the field by Mr. Johnson's correspondent, was of this species.

NATURAL ENEMIES.

No insect parasites or evidences of contagious disease have appeared in our studies of these insects,* and, so far as we now know, birds are their only natural enemies. Turkeys and chickens are reported by Glover and others to feed upon them, and I have found them also in May and June in the stomachs of four species of birds,—the catbird, the brown thrush, the field sparrow, and the black-throated bunting.† The numbers taken by these species must be insignificant, however, except possibly the last, which is a very common bird of our meadows and pastures, and may afford some appreciable protection to the cultivated grasses.

REMEDIES.

This section must, unfortunately, be disproportionately brief, as there is little in the habits and histories of these "bill bugs" as at present understood to encourage a hope of destroying them.

The failure of *ochreus* to breed in corn when afforded every opportunity to do so, makes it likely that this large species will prove only an occasional and temporary annoyance, disappearing as fast as its native haunts are drained and cultivated. Its ascertained injuries can at any rate be evaded by raising flax as the first crop on swamp sod,—already a practice with some farmers in our large drainage districts.

Robustus, which is known to breed in corn and to winter, at least as a usual thing, as an adult in its pupal cell within the roots and stalk, may be destroyed by plowing up and burning the stubble; but the same measure would not necessarily apply to the two species *parvulus* and *sculptilis*, now permanently injurious to corn in Illinois. *Parvulus* is mainly a grass beetle, and probably

* The beak and head of a single hibernating specimen collected by Mr. Weed were covered with mites.

† See Bull. Ill. St. Lab. Nat. Hist., Vol. I., No. 3, p. 120; No. 6, pp. 12, 28, 29, 32.

rarely breeds in corn, while the breeding plant of *sculptilis* is unknown, and the fact that it is sometimes taken free in fall makes it unlikely that the adult hibernates commonly where the larva feeds.

Until the needed facts concerning the less known species are ascertained, we can only suggest that the encouragement of the prairie birds,—especially such as the black-throated bunting, the meadow lark, and the quail, which feed mostly upon insects collected on the ground,—the draining and cultivation of swampy tracts covered with coarse grass, and the insecticide measures common to an intelligent agriculture,—such as the burning of places of resort for hibernating insects,—will be suitable safeguards against these species. In case their attack is anticipated or early detected, the application of Paris green or London purple about the base of the plants would in all probability protect the corn,—a measure of easy application and not excessively expensive.

ECONOMIC BIBLIOGRAPHY.

1. 1789–1808. OLIVIER, A. G.—Entomologie, ou Historie Naturelle des Insectes, V.
2. 1801. FABRICIUS, J. C.—Systema Eleutheratorum, II., 429.
3. 1824. GERMAR, E. F.—Insectorum Species Novæ aut Minus Cognitæ, 301.
4. 1831. SAY, THOMAS.—Descriptions of New Species of Curculionites of North America. Ed. LeConte, I.
5. 1837. SCHÖNHERR, C. J.—Genera et Species Curculionidum, IV.
6. 1845. SCHÖNHERR, C. J.—Idem, VIII.
7. 1853. MELSHEIMER, F. E.—Catalogue of the Described Coleoptera of the United States, 89.
8. 1854. GLOVER, TOWNEND.—Report of the Commissioner of Patents, 67.
9. 1855. UHLER, P. R.—Proceedings of the Academy of Natural Sciences of Philadelphia, VII., 416.
10. FITCH, ASA.—The Cultivator, III., 221.
11. 1857. FITCH, ASA.—Idem, V., 273.
12. 1858. LECONTE, J. L.—Proceedings of the Academy of Natural Sciences of Philadelphia, 80.
13. 1860. GEDDES, GAMBLE.—Transactions of the New York State Agricultural Society, XIX., 331.
14. 1863. GLOVER, TOWNEND.—Report of the Commissioner of Agriculture, 573.
15. 1866. LACORDAIRE, TH.—Genera des Coléoptères, VII., 295.
16. 1867. COUNTRY GENTLEMAN, XXX., 17.
17. WALSH, B. D.—Practical Entomologist, II., 117.

18. PRAIRIE FARMER, XX., 21.
19. 1868. RILEY, C. V.—*Prairie Farmer*, XXII., 26.
20. 1871. GLOVER, TOWNEND.—Report of the Commissioner of Agriculture, 1870, 68.
21. RILEY, C. V.—Third Annual Report on the Insects of Missouri, 59.
22. 1873. CROTCH, G. R.—Check List of the Coleoptera of America, North of Mexico, 123.
23. HORN, G. H.—Proceedings of the American Philosophical Society, XIII.
24. 1874. LEBARON, WM.—Report of the State Entomologist of Illinois, V.
25. 1875. PACKARD, A. S.—U. S. Geological and Geographical Survey of the Territories, 718.
26. 1876. POPENOE, E. A.—Transactions of the Kansas Academy of Science, V., 39.
27. SNOW, F. H.—*Idem*, V., 20.
28. LECONTE, J. L.—Proceedings of the American Philosophical Society, XV.
29. 1877. THOMAS, CYRUS.—Report of the State Entomologist of Illinois, VI., 144.
30. 1878. THOMAS, CYRUS.—*Idem*, VII., 34.
31. SCHWARZ, E. A.—Proceedings of the American Philosophical Society, XVII., 468.
32. HUBBARD, H. G., AND SCHWARZ, E. A.—*Idem*, XVII.
33. 1879. DURY, CHARLES.—Journal of the Cincinnati Society of Natural History, October, [14].
34. LINTNER, J. A.—Annual Report of the New York Agricultural Society.
35. LINTNER, J. A.—Cultivator and Country Gentleman, XLIV., 439.
36. 1880. COMSTOCK, J. H.—Report of the Commissioner of Agriculture, 1879, 248.
37. AUSTIN, E. P.—Supplement to the Check List of Coleoptera of America, North of Mexico, 54.
38. LUGGER, OTTO.—Cultivator and Country Gentleman, XLV., 311.
39. 1881. COMSTOCK, J. H.—Report of the Commissioner of Agriculture, 1880, 272.
40. HARRINGTON, W. H.—Report of the Entomological Society of Ontario, 1880, 56.
41. RILEY, C. V.—*American Naturalist*, XV., 915.

42. RILEY, C. V.—Index to the Nine Reports on the Insects of Missouri, 54.
43. 1882. HENSHAW, SAMUEL.—Transactions of the American Entomological Society, IX., 268.
44. LECONTE, J. L.—Idem, IX., p. xxxvi.
45. RILEY, C. V.—Report of the Commissioner of Agriculture, 1881-82.
46. LINTNER, J. A.—Report of the New York State Entomologist, I.
47. 1883. LECONTE, J. L., AND HORN, G. H.—Classification of the Coleoptera of North America, 507.
48. LINTNER, J. A.—Cultivator and Country Gentleman, Aug. 16.
49. 1884. HARRINGTON, W. H.—Ottawa Field-Naturalists' Club, Transactions, No. 5, 85.
50. HAMILTON, JOHN.—Canadian Entomologist, XVI., 190.
51. RILEY, C. V.—Report of the Commissioner of Agriculture, 413.
52. 1885. HENSHAW, SAMUEL.—List of the Coleoptera of America, North of Mexico, 146.
53. LINTNER, J. A.—Report of the New York State Entomologist, II.
54. WEBSTER, F. M.—Report of the Commissioner of Agriculture, 315.
55. 1886. HUNT, THOMAS F.—Miscellaneous Essays on Economic Entomology by the State Entomologist [of Illinois] and his Entomological Assistants.
56. FORBES, S. A.—Canadian Entomologist, XVIII., 177.
57. FORBES, S. A.—Entomologica Americana, II., 174.
58. WEBSTER, F. M.—Insects Affecting the Corn Crop, 16.
59. 1887. WEBSTER, F. M.—Report of the Commissioner of Agriculture, 1886, 580.
60. 1888. WEBSTER, F. M.—Idem, 1887, 149.
61. FORBES, S. A.—Prairie Farmer, July 14.

OBSERVATIONS OF THE FOOD OF THE SNOUT BEETLES.

(RHYNCHOPHORA.)

It seems to have been generally supposed that the principal damage to corn by the "bill bugs" (Sphenophori) is done by sucking the sap,*—a supposition of which my field observations have given me no proof, and which I have consequently tested by dissection.† Finding the facts thus ascertained of some interest, I have extended my observations to other snout beetles, and present here a summary of the results.

Examples of *Rhynchites bicolor*, a snout beetle of medium size, taken from the rose July 7, 1885, contained a considerable quantity of netted-vein vegetation, fragments of which were still green, the cells containing chlorophyll grains. The vascular tissue was wholly made up of spiral cells clearly derived only from the leaves of the plant. There was, however, no epidermal tissue present. These beetles had evidently been feeding on the leaves of the rose.

An example of *Rhynchites hirtus* was taken July 6; 1884, on one of the common rosin weeds, *Silphium integrifolium*. Many of the stems of this plant had been partly cut through about three or four inches from the top, so that the part above the cut hung down, partly withered. In each case where the injury seemed to be recent, a specimen of the above *Rhynchites* was found among the half-withered leaves, the beetles having their beaks buried in the stems. No eggs or larvæ were discovered; and I can only surmise that the stem may have been deadened by the cut to soften the tissue or to prevent the too rapid flow of the gummy sap.

The crop of the specimen taken in this situation was filled with a mass of vegetation containing large numbers of spinous hairs and spiral vessels. In the intestine was a smaller quantity of the same material. These tissues were evidently derived from the plant on which the beetles were found.

Another example of this species of *Rhynchites* ("taken on flowers" July 23, 1885) contained an abundance of spherical pollen covered with very acute long spines and some of it imbedded in fragments of anther tissue.

*Rep. Ent. U. S. Dept. Agr., 1882, p. 139; Rep. State Ent. N., Y., 1882, p. 254.

† See page 70.

Another, taken in a different place, in July, 1885, contained precisely the same food as the preceding. These specimens were evidently eating the anthers of the plants on which they were found.

□ Examples of *Epicerus imbricatus*, sent to the office May 29, 1885, as injurious to the foliage of the pear, were found by experiment to feed freely upon pear leaves, and also to lay their eggs upon these leaves, concealing their deposit by gumming another leaf to the surface. Specimens of this beetle obtained in a sweet-potato field May 28, 1888, were found by dissection to have fed chiefly upon leaves of grass, and possibly also on some other parallel-veined vegetation. Confined with blue grass and *Setaria* (pigeon grass) in a breeding cage, the former was not touched, but the latter was freely eaten, circular notches being bitten out of the edges of the narrow leaves. Three pairs were noted in copula between May 28 and June 6, but no eggs were obtained, and the beetles, refusing to feed, gradually died.

An example of *Lixus concavus* found on weeds July 7, 1885, had the stomach empty, but the intestines filled with vegetable tissues, nearly all spiral vessels,—the undigested residue of the leaves of plants. Another specimen, taken from wild sunflower (*Helianthus*) August 28, had the crop filled with leaf structures, mostly jointed hairs, many of them with inflated bases. Occasionally a portion of leaf surface was seen covered with hairs of this description: and a considerable quantity of spiral tissue likewise occurred. This beetle had seemingly been gnawing off the stout hairs from the surface of the leaf.*

Finding my horticultural friends who wished to experiment with the arsenical poisons for the destruction of curculios (*Conotrachelus nenuphar*) on the peach and plum in doubt as to the feeding habits of the adult, and uncertain, therefore, whether the species was subject to poisoning by this method, I confined with leaves of the plum in June a number of living specimens. The next day one was observed making a deep oblong excavation in the mid-vein of the leaf, similar work being apparent on the other veins and on the petioles and stems. The beetles were also eating the surfaces of the leaves, but less generally. Later, many small holes were made through the leaves, especially the younger terminal ones. In July, removing the leaves and substituting green plums, I presently found these peppered with cavities, some of which contained eggs, and others not. When both leaves and green fruit were offered the beetles, both were eaten. — the fruit, perhaps, most freely. I need hardly add that experiments with poison were entirely successful.

* *Lixus terminalis* we bred this season from larvae found in the stems of smartweed (*Polygonum pennsylvanicum*) July 24, eggs occurring at the same time. These beetles emerged from Aug. 25 to 28.

Two examples of *Mononychus vulpeculus* taken May 31, 1885, upon the flowers of *Iris versicolor*, had fed upon the pollen of that plant, and also upon leaf tissue,—the latter recognizable by the abundance of spiral vessels.

Two examples of *Rhinoncus pyrrhopus* obtained at Normal in September of 1880, had nothing in the crop, but there was a considerable quantity of food in the intestine,—unquestionably leaf tissue, as shown by the numerous bundles of minute spiral vessels distributed through the fragments.

One of the nut weevils, *Balaninus uniformis*, a small species with a long and slender snout, contained but little food, and that the mycelium of one of the black, incrusting fungi belonging to the Sphæreacei,—probably *Fumago*.

Ten other specimens, four of which were sent me by Dr. Riley and the remainder by Mr. O. S. Westcott, contained no traces of food in the alimentary canal, and I consequently think it probable that these long-snouted beetles may be found to take fluid food most commonly. The dissection of fresh beetles will be necessary to determine this point.

THE MEADOW MAGGOTS OR LEATHER-JACKETS.

(*Tipula bicornis*, Loew, MSS., et al.)

Order DIPTERA. Family TIPULIDÆ.

(Plate VI., fig. 4.)

Few can have failed to notice frequently the large slender-bodied, pale brown flies with excessively long and slender legs, abundant on grass lands in early summer, and very generally known in America as crane-flies; but larvæ of these insects are much less frequently seen, and have received practically no attention in this country from economic entomologists. By Harris, for example, the Tipulidæ are not mentioned in his standard work on "Insects Injurious to Vegetation." In the Missouri Reports* they are barely referred to as "underground vegetable-feeding larvæ." In the Reports of the State Entomologists of Illinois they have been mentioned only by Thomas, and by him were not considered as injurious. In Lintner's Reports as State Entomologist of New York they are barely noticed. In Packard's "Guide to the Study of Insects" they are treated only in a general way, and the larvæ of the principal genus, *Tipula*, are said to live in garden mold and under moss in fields and woods. In the writings of the U. S. Entomologists, they are referred to only by Glover, who briefly discusses the habits of some of the European species. "In this country, however," he adds, "we do not appear to suffer so much from these insects as in England, where the climate is more moist and the frost is not severe as with us; and probably, also, our hot, dry summers are not so favorable for their increase."† In the "Prairie Farmer" of Chicago for April 6, 1867, is a brief article on larvæ of Tipulidæ ("Meadow Worms") by Dr. Riley, written in response to an inquiry concerning large numbers of these larvæ found crawling upon snow in a meadow. "Thousands of them could have been picked up on a rod square." Riley here says that "they may always be found in large numbers in the fall of the year in the humid grounds of meadows, where they remain a couple of inches below the surface feeding upon the vegetable portions of the soil, as also upon the roots of grass. Their numbers are, at times, so immense that they do

* 2d Rep., p. 132.

† Rep. Com. Agr. 1872, p. 128.

considerable damage by detaching and causing the roots to dry, though these effects are usually attributed by farmers to very different causes."

While the observations recorded in the present paper were in progress, I published in the "Prairie Farmer" of Chicago, for May 14, 1887, a brief illustrated notice of the occurrence of these insects in the meadows and pastures of Southern Illinois, connecting them with a serious destruction of the roots of grass and clover and a consequent deadening of considerable patches in meadows and pastures. In this article was given also a brief summary of the results of feeding experiments.

In a letter received from Dr. Riley, of the U. S. Department of Agriculture, June 24, 1887, I am informed that one species did great injury in California, in 1874, to growing grass, alfalfa, and clover. "They seemed," he says, "to show a preference for open soil, and cut off the plants about three fourths of an inch from the surface, working in colonies and occupying areas from one eighth of an acre to five acres." The species here complained of he thinks identical with *T. tephrocephala*, which is very common all over the Eastern United States and is not unfrequently found very thick in grass lands. The injury in California was briefly referred to by Dr. Riley in the "New York Weekly Tribune" for April 8, 1874. In the same letter *T. bicornis* is mentioned as received from Indiana in 1884, where, however, it was not known to be especially injurious. In England, and on the Continent, some species are very widely known to farmers and gardeners as destructive enemies of forage plants, small grain, turnips, cabbages, and the like, and are treated in every general work on farm and garden insects. Our American species have apparently different average feeding habits, and depend, it is to be presumed, much more exclusively on dead and decaying vegetation than do the more abundant of their European allies. I am not aware, however, that precise experiments have hitherto been made to learn the choice of food made by our common leather-jackets, or meadow maggots (as they have lately been called in Illinois); and it is possible that they do more general and considerable injury than has been suspected.

Concerning a single species, the commonest here in 1886 and 1887, I have recently collected information which shows it to be capable of at least intensifying the damage done by drouth to meadows of clover, blue grass, and timothy. A very general and serious injury to grass and clover lands in many parts of Southern and Central Illinois—severest and most general to the southward—was frequently associated in those years with great numbers of large, dirty gray, footless maggots—the larvæ of this insect—found among the roots, where the latter had been so eaten away that the plants were killed and loosened from the ground, often in patches of considerable size. Specimens collected here contained in their stomachs a mixture of dead and living vegetation,—roots and leaves of grass,—as did others placed in sod and kept under observation in breeding cages.

DESCRIPTION.

Larva.—Larvæ of this description may be known from any others occurring in fall or spring in similar situations by the following obvious characters: The body (one and one tenth inches long when full grown) is nearly cylindrical, dirty white or gray, without color-markings of any kind, much wrinkled transversely, about one fifth as broad as long, rather blunt behind and somewhat narrowed forwards to the head. The latter is very small, but distinct and hard, yellowish or brown in color, and commonly much withdrawn within the following segment. There are no feet or legs, nor any trace of them, the larva being a true maggot, but at the bluntish hinder end are a few fleshy or finger-shaped processes, and in full grown specimens a pair of small horny hooks. The general surface is without warts or other processes, but has several very sparse longitudinal rows of short stout black hairs which help in subterranean locomotion. The larva moves with considerable activity, stretching out the body and hooking itself forward by the head.

Pupa.—When it has finished its course of growth and development it transforms into a long, rough, spiny, dirty brown pupa about three fourths of an inch long, the abdomen some three fifths the entire length, and the thorax with clearly visible wing-pads, developing legs, etc. From the back, just behind the head, spring two divergent horn-like structures (breathing tubes), whose length is about equal to the width of the segment from which they arise. Sides of the abdominal segments with sharp keel, which is set with a row of short recurved spines. Another close-set transverse row of conical spines near the posterior edge of each segment of the back, and similar rows of larger spines beneath. On the last segment these rows unite behind the carina to form an unbroken circle of spines,—two or three dorsal members of the row more minute. Behind these, a pair of still stouter spines and a cluster of four blunt anal tubercles. Each abdominal segment with a transverse groove above and below, not reaching the lateral carina. Thorax behind the breathing tubes transversely rugulose; between them a longitudinal carina.

Imago.—The imago is a yellowish brown insect of medium size; the abdomen dusky-shaded, the wings yellowish at base and on costa, fuliginous at tip, with a smoky stigma and a single imperfect white bar immediately preceding it. No other white blotches. The eyes are green; the thorax indistinctly striped dusky and yellowish brown. The following detailed description will serve to distinguish it as a species.*

Length 12 to 13 mm. Male dilute ochreous. Head concolorous, usually a little yellowish behind; rostrum slightly darker; palpi yellowish, darkened towards tip; two basal joints of the antennæ yellowish, the first about as long as the two following, the second

* Failing to identify this species, I referred it to Drs. Williston and Hagen, the former of whom did not recognize it, while the latter informed me that it was in the Loew collection under the name of *Tipula bicincta*, but had never been described.

short, about as wide as long; joints beyond the third becoming darker distally, darkest at base of each, infusate, with verticils of stiff black hairs and a dense pubescence. Prothorax yellowish brown above with two or four darker stripes, the middle pair broadest before, mesonotum and metanotum paler, pleura gray; knob of halteres infuscated. Abdomen and male forceps yellow, with a rather broad black median shade, faint on the first segment and distinct on the others, sometimes involving nearly the whole abdomen. Hypopygium very large; dorsal piece pubescent, tumid, inflated; upper division emarginate at tip, its lateral angles bilobed, outer lobe the longer and curved outwards and upwards. Lower division of dorsal piece emarginate at tip. Coxæ gray, legs yellowish brown, darkening distally to the tarsi, which are mostly black; femora and tibiæ a little darker at apex. Wings slightly infuscated, darker at tip, beyond the basal cells; the base of wing, its front margin (costal and marginal cells), and a narrow area behind the fifth longitudinal, all yellow. Stigma dark, and the usual white space stretching from it along the small cross-vein and across the discal cell, whitening the veins in its course. No other white spots.

The female, more yellow than the male, especially abdomen, wing veins, and legs, the tarsal joints in one specimen showing but little brown. The palpi, two basal joints of the antennæ, and first three joints of the flagellum yellow, the remaining joints dark brownish at the base only. The short horny valves of the ovipositor are slightly curved, and are covered above by a thin, leathery, three-lobed flap, the middle lobe being nearly concealed beneath two outer, superior ones.

We do not yet know of the occurrence of this species in Northern Illinois, although it is very probably not less common there than in the central and southern part of the State, where the winged insect is, in its season, one of our most abundant species.

LIFE HISTORY AND INJURIES.

This species hibernates as a larva nearly or quite full grown, as shown by our collection made in Edwards county April 6, 1888, and in Effingham county on the 16th. At Edgewood nearly all had changed to the pupa by the 3d May, at which time a single larva was also found, and a single empty pupa case. Breeding-cage specimens from Southern Illinois began to emerge May 4, and continued to do so until the 28th May. By May 10, these flies were found common in meadows near Carbondale; and at Urbana, May 19, they appeared in numbers at the electric light and flying about in meadows. The latest specimens of the season were collected May 31. No eggs were obtained, but pairs were seen *in copula* late in May (19 to 31) in both fields and breeding cages. The immediate copulation of the imagos, and the immense

numbers of eggs presently developed by the female, together with the early disappearance of the winged fly, are all evidence that the eggs are soon laid. The time of hatching was not ascertained.

Our first observations on possible injuries by these insects were made at Albion, in Edwards county, April 6, 1888, when these larvæ were found in great numbers at the roots of timothy and clover which had been killed the previous year,—the injury first attracting attention shortly after the fields had been mowed. The timothy had here suffered worst, the bulbs, whose roots had been cut away just below the surface, lying in great numbers on the ground. The larvæ were at the surface in April, feeding largely on dead vegetation. In some parts of the field they averaged one or two to the square foot; and occasionally nearly every stool of timothy was infested. April 16 a similar condition of meadows was found at Edgewood, similarly associated with the tipulid species above described,—the injury being here much more general (chiefly in timothy meadows) than in Edwards county. Here, as in the other situation, the timothy bulbs could often be raked up by the bushel, the roots having been generally eaten away. The fields infested were of various ages, one of the worst—on which there had evidently been an excellent stand—being but two years old. Here, as before, the maggots varied in number from one to two or three per square foot.

As there was nothing in these observations to make it certain that these larvæ had done the damage with which they were connected, experiments were made to ascertain their feeding habits. Tipulid larvæ from these situations were placed, April 16, in pots of sand with growing oats and wheat, and ten days later were dissected for a study of their food. A single larva examined had the alimentary canal well filled with vegetation, full ninety per cent. of it fresh roots. The dead matter was not impossibly from food taken before the experiment began.

On the other hand, two specimens from among the dead grass at Albion, collected there the 6th of April, had these proportions of food reversed, about four fifths to nine tenths being now derived from dead grass and the remainder from living. At Edgewood, however, where the vegetation was less thoroughly killed, about two thirds of the food of two specimens and about one half that of another consisted of fresh grass leaves. These particulars create, it must be admitted, only a presumption to the effect that these tipulids were responsible for a considerable part of the damage to meadows in Southern Illinois; but their habit of mixed feeding makes evident their capacity for mischief where they are exceptionally abundant, and where drouth or other unfavorable conditions render grass specially sensitive to insect attack.

To learn the extent of the phenomena above reported, a circular of inquiry containing a brief description of the larva and of its supposed injuries was addressed to the crop correspondents of the State Department of Agriculture. In reply, Mr. C. L. Sweet, of Glenwood, Cook county, wrote April 25 that he had found an

insect answering completely to my description in dead patches of his meadow, which he had first noticed the preceding fall. From Eberle, Effingham county, Mr. Geo. Strong wrote of the occurrence of the meadow maggot in no very great numbers, adding that his attention was first attracted to it by the work of the hogs in pasture and meadow, rooting up patches of the sod. From San Jose, Mason county, Mr. Wm. M. Duffy wrote that deadened patches such as I described were very numerous, and that on May 4 he found in these patches a few of the maggots mentioned. From Arlington, in Bureau county, Mr. Louis Zearing wrote April 25 that this insect was not a new thing in his vicinity, but made its first appearance there fifteen years before, its ravages being then almost exclusively confined to blue-grass sod. From Milton, Pike county, Mr. J. O. Bolin reported that for two years these insects had injured his pastures in small patches, mostly blue-grass sod; and Mr. E. H. Robb, of Waynesville, DeWitt county, wrote April 27 that he found them in both meadow and pasture by the thousand, having first noticed them some six weeks before, when breaking up meadow for corn.

The injuries thus far reported are not of a gravity or frequency to make special remedial measures seem important. Indeed, in the Old World, where these insects are very much more destructive than here, and have been long well known, no remedies have been devised which are satisfactory or would apply to our agricultural conditions. If our species becomes so destructive as to require special attention, it will probably be found best to plow up the sod and plant to some other crop. It is worthy of remark, however, that in a case reported from Los Angeles county, California, by Dr. Riley, great numbers were destroyed by driving a flock of three hundred sheep over their haunts. Close trampling of the earth by the slow passage of a drove of pigs would doubtless answer the same purpose, which is that of destroying the larvæ lying free upon the surface or barely imbedded among the roots of the grass.

NOTES ON CUTWORMS.

Order LEPIDOPTERA. Family NOCTUIDÆ.

The damage done by cutworms in 1888 to the crops of Illinois far surpassed anything of the sort ever before recorded in the State in amount and range and in the period of its continuance, not the least remarkable feature of it being the fact that it was due chiefly to a single species not recognized by any of our entomologists in its larval state, and of whose habits and history nothing whatever had been recorded. Successful breeding experiments have given us the essential facts concerning this species, new to economic entomology; and I take advantage of the discussion thus called for, to bring together a number of miscellaneous notes of recent accumulation concerning several other species of cutworms observed in this State. Precise data with respect to the period of activity of the various species are of especial economic importance, since upon this depends the time when the crops infested by them may safely be replanted.

The unprecedented outbreak of 1888 was foreshadowed in 1887, as is shown by the following field notes of an assistant, Mr. C. M. Weed, taken as examples of many similar observations:

"Urbana, April 21, 1887. Cutworms are very common in grass lands everywhere this spring. Collected nearly fifty here this afternoon. Are especially abundant under boards along fences. April 22. Cutworms very numerous under boards in pasture, twenty-three under a single fence board. Collected two hundred and fifty in three hours."

"Carterville, Williamson county, May 10, 1887. Corn cutworms doing serious injury. All of one species. [This proved to be the same as that the most destructive the following year, repeatedly bred by us to the imago of *Agrotis morrisoniana*, Riley.] Ate everything in one garden: beans, sweet potatoes, five hundred strawberry plants, onions, corn, etc. Twenty acres of oats also destroyed."

From Waynesville, DeWitt county, a farmer wrote me May 18, 1887, that cutworms had cut off his potato vines, water-melons, and musk-melons; and at Urbana, May 31, we noticed cutworms yet working on the corn, most of them full grown, but occasional specimens much smaller.

Besides the species above mentioned, *Nephelodes violans* and *Agrotis subgothica* were last year especially common in Central Illinois.

In 1888 a chorus of complaints arose from every part of the State; first at the south, where the cutworm hordes were often mistaken for the army worm; and later from Southern and Northern Illinois. Besides their unprecedented numbers, these cutworms were remarkable for their indiscriminate feeding habits and for the long period of their mischievous activity. The severity of their attack upon potatoes, especially,—a plant not commonly considered liable to injury by these insects,—suggested for them in many places, the common name of the "potato cutworm."

Of course several species were concerned both years in this attack, the dominant ones not being the same, however, in the two. In 1887, the commonest were the W-marked cutworm (*Agrotis clandestina*) and the bronzed cutworm (*Nephelodes violans*); but in 1888 the clay-backed cutworm (*Agrotis morrisoniana*) was by far the most numerous and widely distributed.

The well-known *Agrotis subgothica* was also extremely numerous, but of much less importance than the preceding; and in one case *Agrotis ypsilon* destroyed several acres of corn.

The unexampled continuance of the outbreak, reaching, as it did, far into June and even into July, was explained when the life history of the most abundant species was ascertained.

Taking up in order those on which notes have been made deemed worthy of publication, I will discuss more fully the injuries of the season when treating of the kinds most concerned in them.

THE W-MARKED CUTWORM.*

(*Agrotis clandestina*, Harris.)

(Plate V., fig. 1.)

This common species, not extraordinarily abundant here in 1888, was, as already mentioned, unusually common in the central part of the State in 1887.

DESCRIPTION OF LARVA.

The current description of this species does not apply to our specimens with recognizable closeness, and I add a description drawn up from four lots collected in Central Illinois in 1887. The species is distinctly marked, even to a casual inspection, by four rows of conspicuous black spots, two subdorsal, and one upon each side, having the spiracles at their lower edge. The subdorsal spots are more or less triangular in outline (most evidently so posteriorly), with the apex forward; the lateral ones oblique.

*This common name, given by Riley, is here continued because it has been already often used in scientific literature. The "W" marks are not evident, however.

The general ground color is ashy finely specked and mottled with dusky, sometimes with a greenish or yellowish tinge. A yellow median line margined with blackish, very distinct upon the cervical shield, fairly evident upon the anterior segments, especially the thoracic, but becoming obsolete posteriorly. A similar subdorsal line, upon which rest the subdorsal triangular black spots. These spots, limited to the anterior part of each segment, are wanting on the thoracic segments, (rarely faintly indicated on the third,) and also on the two posterior segments, although sometimes faintly apparent on the first of these. One or two of the posterior pairs rarely connected transversely by their posterior ends so as to form an irregular semicircle. The oblique stigmatal dashes are confined to the same segments and the same part of each segment as the subdorsal spots. These are sometimes margined by a dusky shade, thus forming a wavy stigmatal band. The anal plate may bear a square brownish patch (traversed by the dorsal line) between the two yellow subdorsal lines and beneath this a triangular black area, with the apex downward.

The head is yellow, much reticulate with brown, with two heavy brown longitudinal bands upon each side of the middle, narrowing forward and embracing between them the immaculate triangular frontal area. Two much narrower and less definite longitudinal brown lines upon each side of the head, with the upper ocelli between them. Under side of head with a dusky shade inclosing a pale area. Mouth parts pale, except the tips of the mandibles.

Spiracular spots bordered below by yellow or flesh-colored patches, sometimes obscured by dusky, occasionally extended to form a substigmatal line.

The species is seemingly single-brooded, and matures early, most of our larvæ finishing their growth in April and early May.

THE SPOTTED CUTWORM.

(*Agrotis c-nigrum*, Linn.)

(Plate IV., fig. 1.)

This species seems to be two-brooded, as already surmised by Coquillett and French, imagoes of the first brood appearing in May and early in June, and those of the second, late in July and in August. For example, larvæ which had hibernated, found abundant in Urbana in April, 1887, commenced to pupate on the 23d of that month, but still occurred May 6 in diminished numbers, of various sizes, from half an inch in length to full grown.

An imago evidently of this brood emerged May 10 from a pupa obtained in Southern Illinois, and another, from the central part of the State, yielded the imago May 29. Ten larvæ taken from cabbage July 16, 1884, entered the earth for pupation July 25, and emerged as adults August 15 to 19. Another imago of this

second brood appeared July 29. Our miscellaneous collections of the imago made by sugaring and from the electric light (where, however, the species rarely appears) bear out the above division into two broods, a lapse occurring from June 13 to August 4, after which the moth was taken occasionally to September 2. The fall brood of this cutworm does little, if any, injury, and the spring brood may ordinarily be expected to cease its mischief by about the first of May.

Among the food plants of the spotted cutworm, we have noticed *Lobelia* and *Helianthus*; and a single specimen was seen in spring to eat the eggs of grasshoppers.

THE CHOCOLATE-STRIPED CUTWORM.

(*Agrotis bicarnea*, Guen.)

(Plate III., fig. 3.)

This species seems not usually destructive in Illinois, but is here mentioned because of the general similarity of its period of development and feeding habits to those of the more injurious species.

DESCRIPTION OF LARVA.

This is a distinctly striped cutworm, of rather light color, especially distinguished by the strongly marked dark stigmatal stripe, the greater distinctness of the lines behind, and the round black spots or dots surrounding the piliferous tubercles upon the posterior segments. These are commonly, but not invariably, much more distinct here than in front. A dusky brown dorsal band, uniform, or with wavy margins, divided by a light median line (which is sometimes obsolete before the middle) occupies the area between the two inner rows of piliferous spots. The dark stigmatal stripe varies from medium brown to dark chocolate or nearly black. It ends on the 11th segment, and on the thorax usually becomes confused with the ground color.

The stigmata are commonly white, rimmed with black. Sides above the stigmatal band dusky flesh-color or cream-color, much specked with black, and divided by a cream-colored subdorsal line bordered with black or brown, the upper border darker and broader on the 9th, 10th, and 11th segments. The inner row of piliferous spots usually much the most conspicuous, often forming two quite evident rows of small circular blotches extending the whole length.

The substigmatal area with a rather distinct cream-colored or flesh-colored band above; below greenish mottled with whitish and brownish. Venter between the prolegs commonly plain, and, like the latter, whitish or pinkish. The remainder of under surface like the lower part of substigmatal area. Jointed legs commonly pale brown.

Cervical shield and anal plate but little darker than the general surface,—both with the median and subdorsal white lines distinct. All the other lines nearly or quite obsolete on the thoracic segments. Head pale shining yellowish brown, with the two median longitudinal dark brown lines very broad and distinct, not meeting at the middle. Another pair of lines just above ocelli, and a variably distinct additional pair at the lower edge of the ocellar region. The remainder of the surface with regular reticulations of brown, except the frontal triangle, which is plain, or sometimes blotched with brown. Length one and one fourth inches.

This cutworm is an early species, is evidently single-brooded, and hibernates about half grown,—the greater part of the brood being nearly full grown in very early seasons by April 1, in ordinary years by the middle of that month. The active life of belated larvæ was practically over May 7, at which time preparations for pupation were noticed. Imagos emerged from our spring larvæ from July 24 to August 8. In the miscellaneous collections of the office the moth has occurred August 4, 12, 14, and 17, and September 2.

Our specimens of this cutworm were obtained from pastures and meadows, and bred on grass.

THE DINGY CUTWORM.

(*Agrotis subgothica*, Haw.)

(Plate III., fig. 4.)

This was the most abundant cutworm in Southern Illinois in 1887; and, next to *morrisoniana*, the commonest and most destructive throughout the State in 1888. Its principal injuries were done in meadows and clover fields, its preference for clover being quite decided, as shown both by observation and by breeding experiments. It was observed also to feed freely in the field on strawberries, corn, wheat, sweet potatoes, and beans. Unlike its still more abundant companion species, its principal injuries were soon finished, the greater part of the brood having ceased their depredations by the first of June.

In our collections, well grown larvæ occurred as early as April 16; and by April 25 a greater part of a large collection were three fourths to full grown. Preparations for pupation had begun May 18, but a few in both field and laboratory continued to feed until the 9th of June, and others were found under ground, as living larvæ, July 19. Moths emerged in 1887 from August 19 to 30. Some specimens less than half an inch long were found hibernating January 24.

DESCRIPTION OF LARVA.

This cutworm is characterized by a distinct buffy gray dorsal area, mottled with dusky and marked with a faint herring-bone pattern of V-shaped dusky shades, apex forward, one to each seg-

ment, embracing the piliferous tubercles, the series connected by a median longitudinal dusky line, or light line bordered with dusky, darkest at the sutures—that is at the apex of each V.

Sides above stigmata dusky, mottled with gray, darkest above.

Substigmatal band dusky mottled with gray, below this a darker band, venter paler. Anal plate dusky, at least at center; cervical shield shining, dusky; each with a lighter median line. Piliferous spots shining black or dark brown, those just behind the spiracles very prominent and large; anterior spiracles in a large coriaceous brown patch.

Head sometimes nearly uniform dark brown, usually whitish, shining, with a dark brown band each side of the middle, and dark brown lines and blotches near the ocelli, the remaining space reticulate with brown. Clypeus with a median brown band, antennal joints one, two, and three, white, black, and brown, respectively. Legs tinged with smoky brown on the outer sides. Spiracles black.

Length 1.25 inches; width of head 4 mm; widest part of body 6 mm.

THE WESTERN STRIPED CUTWORM.

(*Agrotis herilis*, Gr.)

This species I mention merely to record the fact that it was found September 5 feeding in the field on leaves of white clover and water-melon, and that larvæ afterwards bred were still feeding June 20, July 7, and August 3, but had transformed to the imago September 21; while another example found on clover roots beneath the surface May 20 was still in the larval state June 11,

THE CLAY-BACKED CUTWORM.

(*Agrotis morrisoniana*, Riley.*)

(*Agrotis gladiaria*, Morrison.)

(Plate V., fig. 2.)

This, as already remarked, the most abundant and by far the most destructive cutworm of Illinois in 1887, was bred by Riley in 1874 (see foot note below), but described by him only as an adult, and without record of its life history or food or feeding habits.

*The species as above named, not distinguishable by the published descriptions, are considered identical by Riley, as he informs me by letter, January 26, 1889. The synonymical history is peculiar. The species was described by Morrison as *A. gladiaria* (Proc. Boston Soc. Nat. Hist. xvii, 1875, pp. 192, 193), but so briefly that the description was rejected, with several others, by Grote in 1881, as "inadequate" (Bull. U. S. Geol. Surv. Terr. vi, No. 1, p. 151). It was again described by Morrison (Proc. Boston Soc. Nat. Hist. xvii, 1875, p. 214) as "*A. morrisoniana*, Riley," with the remark that it "will be described at length by Prof. Riley, who has bred it for several years and is acquainted with its larval and pupal stages." This second description also came under Grote's condemnation, above, for "inadequacy." The first of these descriptions occupies four lines of text and the second five.

Riley's promised description appears on a later page (286) of the same volume as Morrison's second, above mentioned, and agrees moderately well with our bred specimens,—one of which has

HABITS AND -LIFE HISTORY.

It came first to my own notice in May, 1884, among a small lot of corn cutworms from Henry county, Illinois; but the larva did not again attract our attention until May 10, 1887,* when it was discovered in Southern Illinois making a serious attack on corn in Williamson county, and infesting oats near Carbondale. May 25 it was also noticed in corn fields, with *A. saucia*, near Champaign.

In 1888 the species was first heard from in Edwards county, April 22, as a "clover cutworm previously unknown,"—the specimens sent us being largely full grown (1.1 inch long). In a letter accompanying these larvæ Mr. A. J. McNeely wrote: "They begin at the top of the clover and work downward to the bottom branches. About noon they collect around the roots, where I have found as many as fifteen about one plant."

April 27 I found the clover field near Albion from which these cutworms were taken, very largely laid bare, the whole plant being eaten away to the roots. The larvæ were full grown, everywhere abundant, and making their way to a field of young clover adjacent. No evidence was seen of disease or extensive parasitism.

The same larva was also found in large numbers on the University grounds at Urbana late in April and early in May, feeding at first especially on clover, denuding patches in meadows, and picking the clover out from among the blue grass. May 7 these cutworms were brought in from oats fields on the University farm, and May 21 a large collection of them, ranging from one half to full grown, was made from grass lands, freshly plowed, on this farm. May 29 immense numbers of them were found at Urbana in a little-used roadway adjoining a meadow (from which they had evidently emerged), nearly all full grown and preparing for pupation. The earth in the lane was honey-combed everywhere with holes half an inch to an inch in depth. Thirty-eight specimens were unearthed here from a square foot of ground. A heavy rain having driven them from the earth, vast numbers of them were exposed on the surface, semi-torpid, as if affected by disease.

been identified for me by Mr. John B. Smith. It is there compared with *subgothica* and with the European *vestigialis*, of which latter species Riley thinks it may be a variety merely. His description was drawn up from two males and six females, all bred from larvæ, but no notes on the life history are given.

Morrison again describes the species at some length (Proc. Phil. Acad. Sci. 1875 [printed April 27], p. 59) as *gladiaria*, Morrison citing his original description—the first here given—and comparing with *vestigialis*. His specimens were captured in Canada, in May, and July 9.

The species is next mentioned by Grote (loc. cit., p. 163) under both the above names (Morrison's second description only, being cited for *gladiaria*). Grote notices the similarity of the forms, but finds his supposed specimens of *gladiaria* smaller than types of *morrisoniana*. On page 152 of the same paper, he expresses the opinion that the original *morrisoniana* of Morrison is a synonym of *gladiaria*. Finally, in his new Check List of North American Moths (1882), p. 25, both names, *morrisoniana*, Riley, and *gladiaria*, Morrison, are entered as of distinct species.

*The destructive abundance of the larva in 1887 and 1888 was foreshadowed by the occurrence at the electric light of immense numbers of the imago in September, 1886, our collections of the evening of the 24th, especially, yielding unexampled quantities of the species.

At Savoy, in Champaign county, they were found June 1 moving from grass into corn, and completely devouring the latter as they went, their mode of attack being much like that of the army worm. The area then invaded was about forty rods long by twenty wide. One hundred and twenty worms were counted about a single hill, and during a warm rain the ground was nearly covered by them. The mode of feeding was here seen to be different from that of the cutworms generally, the corn leaf being seized by the pendent tip, drawn down, and eaten from tip to base. These larvæ were nearly all full grown, but a few remained not more than a third the size of the largest. In gardens they were at this time especially destructive to sweet potatoes. Evidences of disease were here apparent, many cutworms being pale and limp, and others shriveled and blackened.

June 3, they were still active in Champaign county in corn fields, about four acres of one field near Philo having been lately destroyed by larvæ which were mostly full grown, some here having already shortened for pupation, but others being not more than half size*.

June 10, they were still rarely seen in potato fields, cutting off the plants at the base, but in corn their work seemed to be at an end.

June 12, they were still abundant and destructive in beans on the experimental farm at Urbana.

June 18, their earthen cells were found one to three inches below the surface in clover fields previously denuded.

In the breeding cages, specimens from Southern Illinois received April 23 and 28, about full grown when taken, reared on clover (which they selected from a sod of clover and blue grass mixed), were full grown May 18. June 9 a few were still feeding, although nearly all had entered the earth and shortened up for pupation.

June 17, only shortened larvæ were found in the cells examined, as again August 6; but September 23 the first imagos appeared. September 27 many more were out, and numerous eggs were found on the dead leaves and stems of clover in the breeding cage. October 4, several others had emerged, and still a few more by October 13. Our miscellaneous electric light collections yielded the imago of this species from September 15, 1886, to September 24; and again from September 12, 1887, to September 20 and 21, at which time collections ceased. At the latter dates they were seemingly increasing in abundance.†

*It was their habit in corn fields to make a short burrow, usually opening at the base of a stalk, the terminal portions of whose leaves would commonly be found eaten away.

†Agricultural correspondents reported to the State Department of Agriculture and to the "Farmers' Review" of Chicago, that cutworms (whose habits make it likely that reference was had chiefly to this species) occurred in destructive numbers in Williamson, Wayne, and Jackson counties in May; and in Brown, Cass, Christian, Coles, Douglas, Ford, Franklin, Grundy, Iroquois, Jasper, Jefferson, Johnson, Lawrence, Macon, Macoupin, Madison, Marion, Menard, Morgan, Moultrie, Schuyler, Scott, St. Clair, Shelby, Tazewell, Vermilion, Wabash, Washington, and Wayne counties in June,—the damage commonly being to clover and grass, or to corn following these crops. In July similar reports came in from the northern counties of DuPage, Winnebago, and DeWitt, and also from Richland county southward.

From the above it is evident that while clover and corn are perhaps the favorite food of this "cutworm," it is rather indiscriminate in its feeding habits, certainly eating also oats, Irish potatoes, sweet potatoes, and beans. It attacks its food plant more like an army worm than a cutworm, and while it shows no tendency to move in hordes like that species, in a definite direction, it may spread regularly outward from a center of greatest abundance.

Most or all of the eggs are evidently laid in early fall, chiefly in clover meadows. The larvæ pass the winter nearly full grown, as a rule, and have in spring an unusually long period of destructive activity, extending from about the middle of April to the first of June, or a little beyond, preparations for pupation beginning not much before the last of May. The period of dormant larval life in the earth is also long, the imagos emerging from the middle of September, to about the middle of October.

DESCRIPTION OF LARVA.

An extremely variable species, but still easily recognized by the absence of bright or conspicuous markings, and by the broad grayish, yellowish, or reddish dorsal band of lighter tint than the rest of the body.

General color dingy greenish gray, or dusky greenish, varying to dark brown, dorsal space varying from reddish brown to straw color, creamy white, or grayish white,—under a lens, dusky, finely mottled with yellowish or grayish. A more or less conspicuous white median dorsal line, bordered by a dusky shade which often becomes a definite dark line. Sometimes the median white line is much interrupted or obsolete, and the dorsal space is rarely a uniform brown with lighter mottlings.

Subdorsal space with two irregular whitish lines (sometimes much broken), the upper nearer to the dorsal space than to the other lateral line. Area between these lines sometimes a little lighter than that above or below. A substigmatal whitish line, sometimes obsolete; venter slightly greenish, generally lighter than sides, but sometimes neutral gray or not different from lateral areas.

Spiracles black; piliferous tubercles rather small, bearing short and inconspicuous hairs. The inner dorsal row of tubercles very small (especially on posterior segments), well within the dorsal band, the outer dorsal row just at its margin; the upper lateral row a little below the lower lateral whitish line; the lower lateral, larger and behind spiracles. Another row of tubercles at some distance below spiracles.

Head rugosely punctate, yellowish brown, much reticulate with dusky, reticulations thickening each side to form curved blackish bands, approaching each other in the middle and diverging and narrowing to base of the mandibles. Side of head sometimes also with a longitudinal dusky streak and a dark ocular patch; frontal triangle dusky or yellowish, conspicuously rugose, front of head

adjacent irregularly rugose; clypeus varying from yellowish to brown, with evident vertical rugosities, this and the labrum usually paler than adjacent parts. Antennæ white at base, darker towards tip. Cervical shield and anal plate brown to black, with the usual three pale lines,—the lateral ones often becoming broad, pale patches.

PARASITES.

The only evidences of parasitism of this species which came to our notice were presented by two lots of larvæ, one obtained at the University June 12, among which, in the breeding cage, was presently seen a mass of parasitic cocoons, which yielded, June 19, a very small species of *Meteorus* seemingly undescribed. From a single cutworm of the other lot, which had apparently shortened up for pupation, several examples of the same parasite emerged July 1, the larva being at this time dead upon the surface.

THE GREASY CUTWORM.

(*Agrotis ypsilon*, Rott.)

(Plate IV., fig. 2.)

This species is mentioned here only to record the fact that in this latitude it was still actively at work in corn fields June 3 of last year. Most of the specimens were, however, full grown, and some shortening up for pupation, although others were scarcely more than half grown. An examination of our breeding cage showed pupæ in the earth on the 17th June, and several imagos had emerged by the 24th. Most of the larvæ of this rearing, however, were parasitized by *Tachina* and *Braconidæ*.

THE VARIEGATED CUTWORM.

(*Agrotis saucia*, Huebn.)

Although the relatively early development of this cutworm makes it probable that it is a two-brooded species, I do not know that examples of a second generation have been taken in any stage. According to Riley's notes, made at St. Louis, it seems to hibernate most commonly as pupa or imago, its eggs having been repeatedly taken in April; but the occurrence of a full grown cutworm of this species in the grass near my office in January, 1888, shows that it sometimes passes the winter in the larval stage.

The caterpillars of the spring brood may feed in this latitude until the first of June, sometimes pupating, however, by the middle of May, and sometimes not entering the earth until the middle of the following month. The imagos in our breeding cages began to emerge June 14, 1888, but the moth did not become

abundant abroad until about the 27th of that month. May 15 the larva was noticed eating tomatoes in gardens in Southern Illinois, and June 1 it was feeding freely upon sweet potatoes in Champaign.

A fuller description than has been hitherto published will be useful for the precise identification of the larva.

DESCRIPTION OF LARVA.

This cutworm may be most easily recognized by the sooty brown color finely mottled with gray, the back slightly darker than the sides, with a small yellow spot on the middle of each of several central segments, and a dark patch on the segment before the last. These median yellow spots are in an interrupted or continuous yellowish or grayish line, and in front of each is a sooty blotch, divided by the median line.

An interrupted pale yellow subdorsal line, bordered above by an interrupted sooty line. A wavy, sooty-brown, crenate stigmatal line, narrowed at the middle of each segment by a lighter extension from the space above, terminating in a pale spot just behind the stigmata. A conspicuous yellow substigmatal stripe, repand above, mottled with red along upper edge, shading below into colors of venter, which are greenish dusky mottled with yellowish gray. Surface smooth, opaque, with a few very short hairs; piliferous spots inconspicuous. Stigmata black, not prominent. Head reddish yellow, with rufous reticulations, a darker line curving over the ocelli. Triangular front bordered each side by a broad black line contiguous at middle, thence less distinct and black and curving outwardly to back of head. Cervical shield not differentiated. On segment 10 the sooty dorsal spots form an indistinct W, less distinctly traceable on the other segments. On segment 11 they are fused into a transverse pentagonal spot, whose posterior border is very distinct, the space behind, and on segment 12 to the anal plate, being pale yellow with rufous reticulations, except for a narrow blackish W on segment 12. Anal plate with obscure dorsal and subdorsal lines. Prolegs shining brownish, dusky at base.

THE PINK-BACKED CUTWORM.

(*Mamestra meditata*, Gr.)

(Plate IV., fig. 4.)

Occasionally, among the more abundant species of the last two years, occurred a cutworm readily recognized by its usually obscure and dusky color, overlaid with a pinkish or orange tint upon the back, and sometimes also upon the lower part of the sides. It was found from February 28 to May 22 in meadows and grass lands lately plowed. Specimens collected at the latter date had entered the earth July 11, and completed their transformation

somewhere between August 1 and September 10, at which latter date several moths were taken from the breeding cage. During the spring of '89 this cutworm has proved to be a fairly abundant species, collected at many dates from the last of February to April 20, varying from very small to about half grown at the time first mentioned, and about an inch in length the 20th of April.

DESCRIPTION OF LARVA.

A dark cutworm, with the back pinkish or orange overlaid with dusky, deepening at the middle to a moniliform dark band, most distinct posteriorly.

Ground color of the dorsal area pinkish gray, or obscure orange gray, brightest posteriorly, minutely mottled everywhere with brown and black. A broad, blackish median band composed of rhomboidal blotches, one for each segment, the series connected by their narrow ends. These blotches break up towards the front into irregular mottlings, or form a diffuse darkish shade, still retaining, however, the appearance of lozenge-shaped patches. Very obscure median pale line, much interrupted, but commonly distinct at the incisures—most so on the thoracic segments. Dorsal area brightening at the margins into a scarcely distinct subdorsal line, clearly separate only on the thoracic segments, and below this a black band broken at the incisures, forming a series of lunate or triangular blotches, widest above. These become continuous on the thoracic segments so as to form a dusky brown band reaching from the subdorsal area to the spiracles. No spiracular markings, but sides finely mottled with gray and brown much lighter than the back and becoming still paler beneath. Piliferous tubercles inconspicuous except at the sides, where those adjacent to the spiracles, above, behind, and below, are of moderate size. Hairs short, small.

Prolegs pale gray, each with a shining black blotch on the outer surface. Thoracic legs dark. Cervical shield very smooth and shining, quite dark, with the usual three longitudinal stripes, pinkish in color, the lateral ones much wider than the median. Head nearly black. Antennæ flesh-colored at base, ringed in black beyond. Anal shield scarcely different from the preceding segment exteriorly. True legs pale brown, piliferous spots at base large, shining dusky. Antennæ pale.

THE BRISTLY CUTWORM.

(*Mamestra renigera*, Steph.)

(Plate V., fig. 3.)

This cutworm, reported by Riley as an August species in gardens in Northern Illinois, transforming in fall, is also a spring cutworm not uncommon in pasture lands. Numerous larvæ, nearly full grown, taken at Champaign April 25, 1888, yielded the imago

by June 18. The moth is attracted by the electric light, and occurred in large numbers August 17, 1886, and again on the 19th, 20th, 21st, and 23d (at this last date numerous), and continuously thereafter until September 23, after which time it was not collected. The following spring it commenced to appear at the electric light on the 19th May, and by the 23d was very abundant, continuing extremely common until June 3. The 6th and 7th June several moths were taken, and additional examples later,—from three to eight at a time, until the 18th of that month, after which only a single specimen occurred—captured July 14. It is thus clearly a two-brooded species, with a short spring interval of mischievous activity, its damage ceasing practically by the first of May.

DESCRIPTION OF LARVA.

A pale, much-striped cutworm, marked by an especially distinct lateral black stripe, and unusually stout, conspicuous black or yellowish bristles. General color yellowish gray, darkened by minute granulations. A pale dusky stigmatal band, bordered with darker, and above this (with a fine white line intervening) a prominent darker band less distinct on the thorax; then, next above, a brownish or reddish subdorsal band, bordered with white, most conspicuous on the thoracic segments. Dorsal space gray, with a broad moniliform dusky shade contained between the inner piliferous tubercles, this traversed by a rather broad continuous median white line. Substigmatal band mottled cream color, paler than stigmatal, and lighter also than the dusky venter. Prolegs with a brown patch outside of bases, and jointed legs similarly colored. Cervical shield not well marked.

Head opaque, with black granulations, darker than usual, very hairy, with the usual curved frontal black bands and darker reticulations on the sides. Antennal joints one, two, and three, white, black, and brown, respectively.

This larva attains a length of one inch.

Described from ten specimens.

THE GLASSY CUTWORM.

(*Hadena devastatrix*, Boisd.)

(Plate IV., fig. 8.)

This is clearly a single-brooded species of rather long-continued larval life. The eggs are laid, and probably also hatched, in autumn, the species wintering in meadows and pastures as a young larva. Examples obtained May 29, in Peoria county, where they were reported as very destructive to corn, were still feeding July 7, but pupated between July 15 and August 3. The imagos had emerged and died by September 21. A single pupa taken from blue grass and timothy pastures August 13, emerged as an adult

on the 25th of that month. The dates of capture of a large collection obtained by miscellaneous work during two successive years in Central Illinois, ranged from July 13 to August 24.

THE YELLOW-HEADED CUTWORM.

(*Hadena arctica*, Boisd.)

This is likewise apparently a single-brooded species, occasionally very injurious to corn, still destructive, according to our observations, the last of May, at which time, however, many of the larvæ are full grown. We have collected the imago at Champaign in the middle of July.

The larva is grayish white (often with a smoky tinge), with translucent skin, easily showing the tracheæ, the movements of the heart, and the tubular Malpighian bodies within. The head is bright reddish brown or bay, darker than the cervical shield, which is a pale, dirty yellowish brown. Mouth parts yellow; jointed legs yellow, darker at tips.

THE BURROWING WEB WORM.

(*Pseudanaphora arcanella*, Clem.)

Order LEPIDOPTERA. Family TINEIDÆ.

(Plate VI., figs. 2, 3, 5.)

In recently plowed sod I found March 28, 1886, a peculiar caterpillar about an inch long, of a soft, indefinite, velvety gray color, darkening forward, conspicuously marked with several large, irregular, shining white areas in the thoracic region, the head and cervical shield being black. Single examples were occasionally collected afterwards, either free or in small masses of herbage webbed together and connected with a tubular burrow in the ground. Several attempts made in 1886 and 1887 to breed this species failed, and the name remained unknown to us until successful experiments in 1888 yielded the thick-bodied purplish brown moth above mentioned. As far as our own observations go, this web worm, although occurring frequently among the cereal crops, would scarcely deserve attention as an agricultural insect; but the following letter, written May 27, 1887, by Mr. J. M. Leighton, of Manchester, Scott county, Illinois,—accompanied as it was by several of the web worms,—shows the species to be capable of considerable injury to corn:

"I send you by to-day's mail an assortment of grubs which are doing a great deal of mischief in this locality. They are entirely different from those we had some years ago, but fully as destructive to corn; so far, however, they have not damaged the grass. Their ravages are confined entirely to sod land, and they only work on the dry portions of that, confining themselves to the highest part of the field. They were first noticed about ten days ago, when the corn was twelve to eighteen inches high and growing rapidly, and in that time they have entirely destroyed a great deal of it. The question that the farmers feel most interested in is, How long will they continue to work?"

The literature of this species is purely technical, no observations on it, of economic interest, having been reported.

The life history of a single related species, *Anaphora agrotipennella*, having similar burrowing habits, was given by Miss Murtfeldt in 1876;* but otherwise I am not aware of any biological observations on any of our American species.

*Can. Ent., vol. viii, p. 185.

DESCRIPTION.

Larva.—A slender caterpillar from $1\frac{1}{8}$ to $1\frac{1}{4}$ inches in length. General color a soft dusky gray, with a peculiar silky look, darkening forward to the head and first thoracic segment, which are shining black. Distinguished especially by large, irregular, shining white or dusky areas on the thorax.

Body slender, a little widest in front. Head but little narrower than first thoracic segment; shining, irregularly transversely rugose, most so on the frontal area; anterior part of frontal triangle with a conspicuous semicircular groove opening forward; head with the usual Y-shaped mark; outside of the arms of this a parallel groove on each side, forming a V, open posteriorly, the anterior ends of these grooves curving inward to the ends of the clypeus. The latter pale and soft; labrum brown, base paler, highly protractile, because of the flexibility of the clypeus. Labium membranous, retractile, with a very long, median, spine-like spinneret, and two slender palpi, three-jointed, the first joint a thick truncate cone, the second slender, cylindrical, the third minute, about one third as long as the second, with a very long tapering spine-like hair at the tip. Maxillæ thick, fleshy; palpus two-jointed, inner lobe with five or six slender peg-like teeth distributed upon its fleshy surface.

Surface of the head with scattered long hairs. Antennæ extraordinarily long and slender when protruded, but remarkably protractile, the first joint being white and membranous, and about as long as the third, which may be wholly retracted within it. Mandibles nearly black, blunt; lower mouth parts pale, except the labium and the distal portions of the maxillæ, which are darker. Ocelli six, in an irregular curve opening backward immediately behind the base of the mandible.

First segment shining black, with obscure irregular transverse rugosities, front margin brown; posterior lateral angles with a large oblique black spiracle. Second segment chiefly shining white, with three V-shaped markings of the ground color,—one median, opening backward, and two lateral, opening to the front. Suture between second and third segments, as well as anterior margin of the third, also shining white, with a large circular white area on each side of the middle line. Sides of this segment with a large shining white patch, bifid posteriorly by a process of the ground color. Remaining segments from the fourth to the eleventh with four dorsal, silvery, shining piliferous spaces, within which the hair springs from a minute black point, these spaces gradually diminishing in size from before backward. On the sides of these segments two rows of similar shining spots, one above the stigmata, the other below; the former composed of one spot to each segment above and behind the spiracle; the latter of two such spots below the spiracle, one before and one behind. From the sixth to the ninth segment a small black pit behind and below the shining piliferous area of the upper row, forming a

triangle with this and the spiracle. Spiracles black, with pale centers, nine in number, the last larger than those preceding. Anal shield black, bristly, the segment preceding with a ring of shining piliferous spots, and two additional spots in front. These last two segments darker than those preceding. Anal plate rugose; cervical shield with a fine median longitudinal white line.

Under surface a little lighter than the upper; first, second, seventh, and eighth segments with large shining piliferous spaces below, arranged in an irregular transverse row. Jointed legs dark without, more or less blackened at base; prolegs thick and large, their tips unicolorous, set with a fine shagreen of minute recurved hooks in addition to the large central series.

Imago.—A thick-bodied, heavily tufted, and woolly-looking moth of a rather dark brownish gray color, with distinct purple gloss, when fresh, on all the wings, the fore wings with lighter median shades, and indistinct spot and five transverse lineations. The following general description must be very liberally applied, as the species is unusually variable in color.

“Palpi luteous brown in front, dark brown externally. Thorax dark brown, almost blackish. Fore wings dark brown, with an obscure purplish hue; with luteous brown on the disc and in the fold, interrupted by a blackish brown, nearly square, submedian spot in the fold and a small one near its base of the same hue (sometimes merely a few blackish brown scales), with an irregular blackish brown spot on the end of the disc, and the costa and apical portion of the wing dusted and dotted, sometimes striated, with blackish brown. Hind wings dark brown, tinged with blackish. Exp. al. 12 lines.”*

Larvæ answering to this description have been taken by us at various places in Central Illinois from the 20th to the last of October and from April 26 to June 3, the specimens taken at the date first mentioned being already fairly well grown. Larvæ placed in a breeding cage April 26, emerged before the middle of July. The moth was very abundant at the electric light during the years 1887 and 1888, chiefly in the month of June, collections ranging from the first of that month to the second of July. None were taken at any other time.

This larva constructs a silk-lined burrow in the earth, from a few inches to two feet in depth, commonly terminating in a little chamber, and opening above in a webbed mass of earth or rubbish into which its silken lining is extended. This web worm is commonest in meadows, but most easily detected in cultivated lands the first year after grass. We have taken it from both corn and wheat following sod, and from gardens, hedge-rows, and the like.

Another species,* related to the above, the larva of which was not distinguished from it,—has a similar life history. Examples of this larva taken April 13 emerged June 17 and 18; while imagoes were taken at the electric light—much less frequently, however, than the preceding species—from the 4th to the 20th of June.

Identified by Lord Walsingham, as I am informed by Prof. C. H. Fernald, as *Ctenogenes mortipennella*, Grote. The original description ("Canadian Entomologist," iv, 137, July, 1872) seems to have been made from a single bleached male, and I subjoin another showing the color variations.

A light-bodied, narrow-winged, pale brown species, the hind wings dusky, and the fore wings speckled, spotted, and minutely barred with dark brown or black. Wing expanse varying from 25 mm. in the smallest male to 84 mm. in the largest female.

In the male the general color is light wood-brown, brownish gray with a tinge of yellowish, or a paler gray, the best preserved specimens sometimes with a slight violaceous suffusion. The strongly recurved palpi, reaching to the base of the abdomen, fuscous at base, otherwise grayish brown, with blackish scales, darker on the terminal segments.

Fore wing commonly more embrowned at base of costa and towards tip, but frequently with a fairly well-defined marginal paler area. The posterior and inner part of the wing usually paler than the rest. The dusky markings commonly sharp, but almost indescribably variable, always showing a strong tendency, however, to the formation of four or five rather conspicuous subquadrate blotches along the middle of the wing, which sometimes fuse to form a zigzag band, as in the figure (Pl. vi, fig. 1). The two most persistent of these blotches are behind the middle, and at the outer end, of the discal cell. The costal region is commonly more or less closely barred with black, and sometimes the posterior margin also, and these lines may extend across the outer third of the wing to form four or five irregular transverse bands. A submarginal row of black points, sometimes quite distinct, sometimes fusing to an irregular line. Fringe with two dark lines, one at the base and one at the tip of the scales.

Hind wing fuscous, with a bronzed reflection, and slightly paler outwards. Abdomen like the hind wing. Beneath, both wings are uniform fuscous, slightly bronzed, the hinder a little the paler.

The females are larger, with porrected palpi, which are light brown above, darker beneath. The general color of the fore wings is a slightly reddened brown.

Described from twenty males and three females.

EXPLANATION OF PLATES.*

PLATE I.

CORN BILL BUGS.

- Fig. 1. The Clay-colored Bill Bug, *Sphenophorus ochreus*; magnified two and one third diameters.
- Fig. 2. *Sphenophorus pertinax*; magnified three diameters.
- Fig. 3. *Sphenophorus robustus*; magnified three and one third diameters.
- Fig. 4. *Sphenophorus cariosus*; magnified four diameters.

PLATE II.

CORN BILL BUGS.

- Fig. 1. *Sphenophorus sculptilis*; magnified four diameters.
- Fig. 2. *Sphenophorus scoparius*; magnified three and one half diameters.
- Fig. 3. *Sphenophorus melanocephalus*; magnified three and two thirds diameters.
- Fig. 4. *Sphenophorus placidus*; magnified five diameters.

PLATE III.

CORN BILL BUGS.

- Fig. 1. *Sphenophorus parvulus*; magnified five and one third diameters.
- Fig. 2. *Sphenophorus minimus*; magnified six diameters.

* All the drawings for these plates were made at the office, by Mr. A. M. Westergren.

CUTWORMS.

- Fig. 3. The Chocolate-striped Cutworm, *Agrotis bicarnea*; magnified two diameters.
- Fig. 4. The Dingy Cutworm, *Agrotis subgothica*; magnified two diameters.
-

PLATE IV.

CUTWORMS.

- Fig. 1. The Spotted Cutworm, *Agrotis c-nigrum*; magnified two diameters.
- Fig. 2. The Greasy Cutworm, *Agrotis ypsilon*; magnified two diameters.
- Fig. 3. The Glassy Cutworm, *Hadena devastatrix*; magnified two diameters.
- Fig. 4. The Pink-backed Cutworm, *Mamestra meditata*; magnified two and one third diameters.
-

PLATE V.

- Fig. 1. The W-marked Cutworm, *Agrotis clandestina*; magnified three diameters.
- Fig. 2. The Clay-backed Cutworm, *Agrotis morrisoniana* or *gladiaria*; magnified two and one third diameters.
- Fig. 3. The Bristly Cutworm, *Mamestra renigera*; magnified three diameters.
- Fig. 4. **Thrips tritici*; magnified forty diameters, and wing greatly magnified.
-

PLATE VI.

- Fig. 1. *Ctenogenes mortipennella*, imago; magnified two diameters.
- Fig. 2. The Burrowing Web Worm, *Pseudanaphora arcanelle*, larva; magnified three diameters.
- Fig. 3. The same, side view.
- Fig. 4. The Meadow Maggot or Leather Jacket, *Tipula bicornis*, larva; magnified three diameters.
- Fig. 5. The Burrowing Web Worm, *Pseudanaphora arcanelle*, imago; magnified three diameters.
-

* In some parts this figure is The Variegated Cutworm, *Agrotis gamma*.



Fig. 1.



Fig. 2.



Fig. 3.

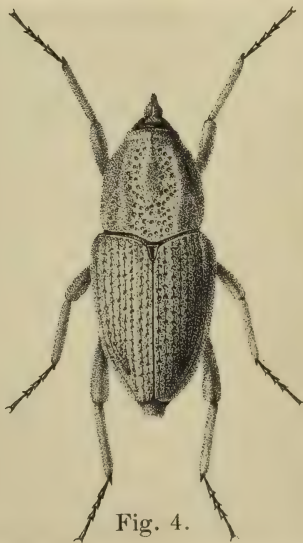
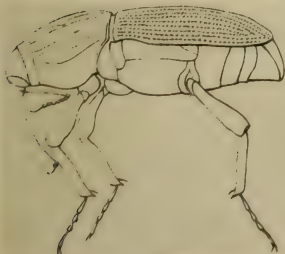


Fig. 4.



THE LIBRARY
OF THE
UNIVERSITY OF ILLINOIS

PLATE II.



Fig. 1.

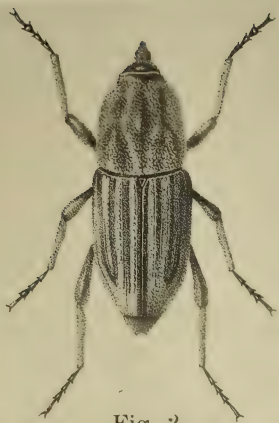
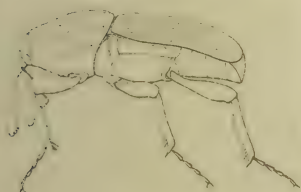


Fig. 2.

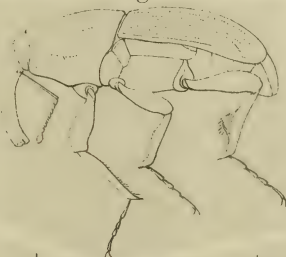


Fig. 3.

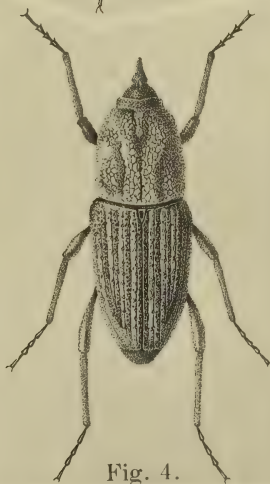


Fig. 4.



THE LIBRARY
OF THE
UNIVERSITY OF ILLINOIS

PLATE III.



Fig. 1.



Fig. 2.

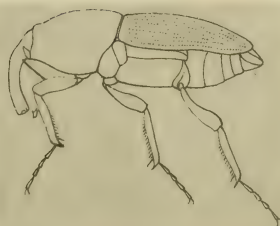


Fig. 3.



Fig. 4.

THE LIBRARY
OF THE
UNIVERSITY OF ILLINOIS

PLATE IV.



Fig. 1.

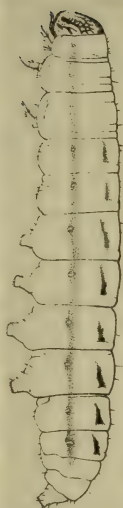


Fig. 2.

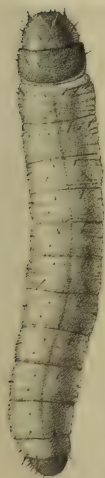


Fig. 3.



Fig. 4.



THE LIBRARY
OF THE
UNIVERSITY OF ILLINOIS



Fig. 1.



Fig. 2.



Fig. 3.



Fig. 4.

THE LIBRARY
OF THE
UNIVERSITY OF ILLINOIS

PLATE VI.



Fig. 1.



Fig. 2.



Fig. 4.



Fig. 3.



Fig. 5.

THE LIBRARY
OF THE
UNIVERSITY OF ILLINOIS

APPENDIX

TO THE

SIXTEENTH REPORT OF THE STATE ENTOMOLOGIST OF
ILLINOIS.

CONTRIBUTION

TO AN

ECONOMIC BIBLIOGRAPHY

OF

THE CHINCH BUG.

1785—1888

INTRODUCTORY NOTE.

As a necessary part of a systematic investigation of the chinch bug from the standpoint of the agriculture of the present day, it has been my duty to scan thoroughly its economic literature with reference to its origin, its native food plants and its relations to nature at large, its spread, its attack upon cultivated crops under varying conditions of latitude, climate, weather, agricultural situation and practice, and the like, and especially its susceptibility to preventive and remedial measures. This task has been so laborious and so irksome that I would gladly save another the repetition of it; and the information obtained, although of very unequal value, seems to me well worthy of re-publication, especially in the interest of those who, connected with agricultural experiment stations in the states subject to the ravages of this insect, will have in future to devise and test measures for meeting its attacks.

In collecting notes from more or less fugitive agricultural literature, I have not thought it best to exercise a rigorous censorship with regard to the accuracy of the matter reported by ordinary observers, or even by entomologists, but have made this record, to some extent, a history of error as well as of discovery. On the other hand, I have not commonly thought it worth my while, or of any benefit to others, to renew the life of unmitigated blunders merely because they have happened at some time to find their way into print.

Concerning the reports of the occurrence or absence of the chinch bug, and the amount of its injuries from year to year in different parts of its area, I have thought it best to give all the information in my possession, since this is an important part of the material necessary to any thorough study of the relations of this insect to weather, crops, and agricultural management. While, of course, I have not exhausted the sources of information on this topic, I have secured everything bearing on it which I could get access to, and have collected, I think, approximately all of any interest concerning the career of this insect in Illinois.

For the clerical work of this appendix I am indebted to my amanuensis, Miss Mary J. Snyder, and to two of my assistants, Messrs. C. M. Weed and John Marten.

S. A. FORBES.

ECONOMIC BIBLIOGRAPHY OF THE CHINCH BUG. 1785-1888.

1785.

WEBSTER on Pestilence, v. 1, p. 279.

Fields of wheat in North Carolina so overrun by chinch bug as to threaten total destruction to the grain. [Not seen. See Fitch's 2d Rept. Ins. N. Y., p. 279.]

1789.

MORGAN, COL. GEORGE.—Chintz bug-fly. (Annals of Agriculture, London, 1789, v. 11, p. 471.) [Not seen. See Can. Ent., v. 20, p. 126.]

1822.

KIRBY AND SPENCE.—(An Introduction to Entomology, 1822, ed. 4, v. 1, p. 170. [See also ed. 7, 1863, p. 92.]

"America suffers also in its wheat and maize from the attack of an insect of a different order; which, for what reason I know not, is called the chintz-bug-fly. It appears to be apterous, and is said in scent and color to resemble the bed-bug. They travel in immense columns from field to field, like locusts, destroying everything as they proceed; but their injuries are confined to the States south of the 40th degree of north latitude. From this account the depredator here noticed should belong to the tribe of Cimicidæ; but it seems very difficult to conceive how an insect that lives by suction and has no mandibles could destroy these plants so totally."

1831.

SAY, THOMAS.—*Lygæus leucopterus*. Descriptions of new Species of Heteropterous Hemiptera of North America, Dec., 1831, p. — (Reprinted in Trans. N. Y. State Agric. Soc., 1857, p. 774; and in Complete Writings of Thomas Say, v. 1, p. 329.)

Original description (written at New Harmony, Ind.) from a single specimen taken on the eastern shore of Virginia.*

*The occurrence of the chinch bug in Illinois as early as 1823 is established by a note from S. A. Forbes, published in "Insect Life" (Washington, D. C.) for February, 1889, p. 249.

1837.

NEW ENGLAND FARMER, v. 16, p. 21.

Note of the prevalence of the "chintz bug" in Cumberland Co., Va. (See Howard's Bibliographical List, Rept. [U. S.] Commiss. Agric., 1887, p. 84.)

1839.

GIBBES, W. S.—[The Chinch Bug.] (Albany Cultivator, ser. 1, v. 6, p. 103.)

Writing from South Carolina, Mr. Gibbes mentions the appearance "within the last two years" of a pest called in Virginia the chinch bug. He describes the insects as similar in size and shape to the "small black flour weevil," and says they can fly, but do so reluctantly. "They penetrate the stalks and suck them to death." His oat crop was totally destroyed; early wheat escaped, but the late was injured. After small grain was harvested, corn covered with myriads of the bugs. Burned over part of field first infested. [See Fitch's 2d Rept. Ins. N. Y., p. 278.]

JEFFREYS, J. W.—[The Hessian Bug.] (Albany Cultivator, ser. 1, v. 6, p. 201.)

Destroyed crops of wheat in Orange Co., N. C., in 1781. [Not seen. See Fitch's 2d Rept. Ins. N. Y., p. 278.]

1845.

PRAIRIE FARMER, Sept., 1845, v. 5, p. 227.

A Hancock Co. correspondent writes that "some [wheat] fields are a good deal injured by the bug or fly." Migrates from winter wheat to spring wheat, then to oats, and finally to corn. Travels like army worm, but is harder to stop. A neighbor plowed ditch around corn field and put in ashes, but it did no good.

PRAIRIE FARMER, Oct., 1845, v. 5, p. 254. Chintz Bugs.

A farmer in Knox Co. reports that "chintz bugs" are eating up wheat and doing extensive damage. "They appear in myriads, defying all endeavors at extermination."

PRAIRIE FARMER, Nov., 1845, v. 5, p. 269. A Wheat Insect.

Report of the appearance of "a small fly, a little more than one eighth of an inch in size," in Will Co., Ill., upon wheat, causing heads to turn white. Migrates from wheat to corn—largely destroying the latter—and then to young wheat, which it "eats off just beneath the surface of the earth." In all stages of growth. Ground perforated by them. Smell like bed-bug. "The ant-eater [Chrysopa or coccinellid?] which preys on the aphids preys also on this insect."

HADLEY, J.—Chinch Bugs. (Prairie Farmer, Dec., 1845, v. 5, p. 287.)

Writes from Tazewell Co., that the bugs appeared about wheat roots in June and got their growth in about two weeks. Eggs laid in ground and hatch in about six days. Supposed to be five or six generations a season [!]. No young in November. Two or three acres of fall wheat destroyed at time of writing [November], and bugs still at work. "They work entirely on the roots of it now, but in summer and early fall devoured roots, stems, and leaves." Reported as injurious about five years previous.

The editors illustrate the insect, and state that it is the same as that described in November issue (p. 269). No new marauder, having been for many years in Southern and Southwestern States. Particularly troublesome in Virginia several years since.

[For notes of still earlier occurrence in Illinois, see "Insect Life," v. 1, No. 8, p. 249.]

1846.

FITCH, ASA.—On the Wheat Fly and Chinch Bug. (Ohio Cultivator, Feb. 1, 1846.) [Not seen.]

MANLOVE, J. B.—Chinch Bugs. (Prairie Farmer, Apr., 1846, v. 6, p. 128.)

Writes from Schuyler Co., Mar., 1846, that millions of bugs are preying on wheat-fields. "Any time during the winter, when frost has not prevented, the surface has been alive with myriads of all sizes and different colors and ages" [?]. "Commence with a corn field and take all as they go."

PRAIRIE FARMER, Apr, 1846, v. 6, p. 129. Chinch Bugs.

Editors are informed that this insect first appeared in Henderson Co. in 1845, and that "every warm spell [during the winter] awakens him to life." Piece of wheat on new land slightly damaged, while an adjoining one was three fourths destroyed. Letter from T. W. Harris states that this insect is probably his *Phytocoris lineolaris*.

NEWSOM, DAVID.—The Chinch Bug. (Prairie Farmer, June, 1846, v. 6, p. 184.)

Writes from Sangamon Co. that millions of bugs were observed in fall of 1844. In June, 1845, appeared in wheat, and did great damage. Migrated to corn, then to prairie grass, weeds, "or any plant that had any substance in it, till all was dried up." Injured early sown wheat to some extent [in fall]. Did not attack oats, clover, or timothy. Hibernated under corn shocks, clods, rails, etc. Two hundred bushels of shrunken wheat obtained from thirty-five acres.

FARRELL, W. E.—Chinch Bugs. (Prairie Farmer, Aug., 1846, v. 6, p. 245.)

Writes from Cass Co., July 11, 1846, that winter wheat is very fine. Not a field of spring wheat worth cutting, because of chinch bugs. Migrate from wheat to corn and oats. Killed several acres of corn.

PRAIRIE FARMER, Sept., 1846, v. 6, p. 265. The Wheat Crop.

"The 'Alton Telegraph' says: 'We regret to add that the chinch bug—a destructive insect hitherto but little known in Illinois—has made its appearance in large numbers in this and the neighboring counties, and attacked the corn and other late crops.'"

PRAIRIE FARMER, Oct., 1846, v. 6, p. 326. The Chinch Bug.

Replying to query of correspondent, editors say they can add nothing to what was stated in 1845, and ask experience of other readers.

1847.

JULIAN, I.—Chinch Bugs. (Prairie Farmer, May, 1847, v. 7, p. 150.)

Writes from Linn Co. Ia., Mar., 1847, that chinch bugs first appeared there in 1846, "materially injuring the spring wheat, and in some instances the corn crop."

HESS, D.—Chinch Bug. (Prairie Farmer, July, 1847, v. 7, p. 211.)

Writes from Clinton Co., Ia., of an insect in corn and wheat. Evidently confounds the chinch bug with the Hessian fly, both of which insects seem to have been present. From the description editors identify insect as the chinch bug.

PRAIRIE FARMER, July, 1847, v. 7, p. 216. The Wheat Crop.

"The fly, the chinch bug, and other unknown insects are doing much damage [to wheat] in particular sections."

1848.

BALL, J.—Chinch Bug. (Prairie Farmer, Sept., 1848, v. 8, p. 294.)

Writes from Lake Co., Ind., that chinch bugs are doing much damage, especially on late-sown spring wheat. Bugs present two years before.

1850.

PRAIRIE FARMER, Aug. 1850, v. 10, pp. 240, 241. The Crops.

In a summary account of crop conditions in Illinois, editors quote from various local papers accounts of chinch-bug injury:

Kane County Democrat: General panic prevails because of bugs. May not have enough wheat for home consumption.

Aurora Beacon: Spring wheat likely to prove a total failure. Corn and oats also attacked.

Mt. Morris [Ogle Co.] *Gazette*: Chinch bugs destroying greater portion of spring wheat. "Also have a fine taste for green corn."

Bureau Advocate: Spring wheat in some neighborhoods is suffering very much from chinch bugs.

PRAIRIE FARMER, Aug., 1850, v. 10, p. 245.

Short editorial account of chinch bug, with poor wood-cut. "Sweeps clean as it goes, covering the plants of wheat or other grain in myriads." Fire had been proposed as a remedy, and were there feasible mode of applying it editor thinks it would answer. "Habits and peculiarities are but imperfectly understood."

W., J. A.—Notes in the Country. (Prairie Farmer, Sept., 1850, v. 10, p. 266.)

Thinks depredations of chinch bugs less serious than have been reported.

PRAIRIE FARMER, Sept., 1850, v. 10, p. 278. The Wheat Crop.

From Kane Co., July 13, "Practical Farmer" writes: "Spring wheat is materially injured, and in some instances totally destroyed by the alarming depredations of a new enemy in the shape of an insect fly or bug. Would not burning over the fields in the fall * * * prevent their increase and development?"

ROBINSON, SOLON.—(Prairie Farmer, Sept., 1850, v. 10, p. 279.)

Writing from Lake Co., Iowa, July 17, 1850, says that "owing to the great drouth this year * * * there are now more bugs than wheat. They are attacking the oats and corn."

LEBARON, WILLIAM.—The Chinch Bug. (Prairie Farmer, Sept., 1850, v. 10, p. 280. Reprinted by Fitch in his 2d Rept. Ins. N. Y., pp. 288, 289.)

Writes from Geneva, Kane Co., Aug., 1850, that bugs are destructive in that region. Season "excessively dry, which has probably been favorable to their multiplication." Appear in June, "confining their depredations at this period chiefly to spring wheat." Suck with 4-jointed beak. Blast wheat, then go to corn, oats, timothy, and some wild grasses, in order named. Ordinarily migrate on foot, but adults sometimes fly in swarms. Eggs not seen; supposed to be laid in earth about roots. Young and adult described at length. Belong to genus *Rhyparochromus*, family *Lygæidæ*, order Hemiptera. Does not know whether the insect has been named, but "it might be appropriately called the *Rhyparochromus devastator*. * * * It is scarcely probable that any preventive or remedy for their devastations will ever be discovered." Hopes nature may have provided some parasitic insect for this species "whose origin and progress seem to be so wholly removed from the reach of human control."

PRAIRIE FARMER, Oct., 1850, v. 10, p. 320. The Chinch Bug.

Editors recommend for trial mixing fall wheat, two quarts to the bushel, with seed spring wheat. Latter, coming up first, "soon becomes tough," while former is slower and more tender for bugs to work on. Similar method of sowing fall wheat advocated. An informant had practiced it three years and considered it an infallible remedy.

1851.

PRAIRIE FARMER, Feb., 1851, v. 11, p. 56. Season and Crops of 1850.

"In some half dozen counties of Northern Illinois, including Kane, DuPage, Will, and DeKalb, the wheat crop was attacked by the chinch bug in most extraordinary numbers, and the greatest devastation was the result." Corn crop injured in some places.

PRAIRIE FARMER, Aug., 1851, v. 11, p. 335. The Chinch Bug.

Editorial note stating that the bug has within two or three previous years been injurious in Will, DeKalb, Kendall, Kane, DuPage and McHenry counties. Attacks wheat, oats, corn, and grass. Not reported in 1851. "The great amount of water has been favorable to their destruction."

HARRIS, T. W.—Chinch Bug (*Rhyparochromus devastator*). (Albany Cultivator, Dec., 1851, v. 8, No. 12, pp. 402, 403.) [Not seen.]

HARRIS, T. W.—(Insects Injurious to Vegetation, ed. 3, p. 198.)

Gives a description of young and adult chinch bug from living specimens. Says, "It is a mistake that these insects are confined to states south of 40°, for I have been favored with them by Prof. Lathrop, of Beloit College, Wis., and by Dr. LeBaron, of Geneva, Ill." Appear in June on wheat and in all stages during the summer "on all kinds of grain, on corn, and on herds-grass." Some continue alive all winter in places of concealment.

1854.

VAWTER, WM.—Season in Missouri. (Prairie Farmer, Sept., 1854, v. 14, p. 326.)

Writing from Monroe Co., Mo., says, "The chinch bug, in some sections, destroyed the corn and wheat crops."

1855.

PRAIRIE FARMER, Jan. 3, 1855, v. 15, p. 36. The Chinch Bug.

The "Warsaw Express" reports this pest as very plentiful in Hancock and McDonough counties the past season. Thinks that as the bugs have no power of locomotion except their legs, plowing, say, ten furrows around a field will keep them out.

PRAIRIE FARMER, July, 1855, v. 15, p. 206. Insects.

Statement that chinch bugs are troublesome in Kane, DuPage, and DeKalb counties, and that they have been reported farther southward.

STRATTAN, M. E.—Jasper County. (Prairie Farmer, Aug., 1855, v. 15, p. 257.)

Chinch bugs almost ruined the crops last year in Jasper, Clay, Richland, Effingham, and Cumberland counties, and did considerable damage elsewhere. Large amount of stock perished with hunger, and breadstuff is difficult to procure because of light yield due entirely to the chinch bugs. They destroyed many acres of oats, and then concentrated upon the corn about the time of silking, killing it completely.

SMITH, E. C.—The Chinch Bug. (The Cultivator, Aug., 1855, ser. 3, v. 3, pp. 237, 238.)

Writes from Christy's Prairie, ——— Co., Ind., that the chinch bug appeared in his vicinity about nine years ago. Goes apparently from wheat stubble to corn and other crops. Begins breeding in May, and correspondent thinks it probable that it is produced in regular succession throughout the entire season. Said to destroy great quantities of the growing crops by sucking juice from the plants. The ravages of five years—1851-55—are described.

FITCH, ASA.—[The Chinch Bug.] (The Cultivator, Aug. 15, 1855, ser. 3, v. 3, pp. 238, 239.)

Commenting on the above article by Mr. Smith, Fitch reports his personal observations on the chinch bug in Northern Illinois the year before, when he found the insect in myriads over a large district of country. Discusses the origin and meaning of the common name; mentions "Mormon louse" as a popular name in Northwestern Illinois; and refers to Say's original description under the technical name *Lygæus leucopterus*. Refers the species to the more recent *Micropus* of Spinola.

IDE, L. H.—Hedges and Chinch Bugs. (Prairie Farmer, Sept., 1855, v. 15, p. 284.)

Reports chinch bugs as having been very destructive to wheat. After wheat harvest went to corn, some of which is being severely injured. Have been worst on late-broken prairie sod, where wheat was injured by freezing in May.

PRAIRIE FARMER, Sept., 1855, v. 15, p. 296. Chinch Bugs.

Reports great consternation in Coles Co., and in counties adjoining, on account of the chinch bug. Some farmers selling out and leaving for Iowa and Kansas. Bugs reported in Pike county.

1856.

FITCH, ASA.—[Insects] Infesting Field Crops. 1. Wheat. Affecting the Stalk. (Second Rept. Ins. N. Y., pp. 279–297.)

An elaborate article on the Chinch Bug (*Micropus leucopterus*), treating of its early history, distribution, life history, injuries, and remedies. Three specimens taken in N. Y. Nine varieties described. False chinch bugs described.

1857.

PRAIRIE FARMER, April 9, 1857, v. 17, p. 113.

A correspondent says, if spring wheat is sown as soon as the frost is out of the ground it will escape destruction by chinch bug.

PRAIRIE FARMER, Aug. 13, 1857, v. 17, p. 262.

Chinch bugs doing much injury in Brown county.

SIGNORET, V.—Essai Monographique du Genre *Micropus*, Spinola. (Ann. Soc. Ent. de France, V., ser. 3, p. 31.)

“A technical description from specimens received from New York and Cuba.” [Not seen. See Howard’s Bibliographical List, Rept. (U. S.) Commiss. Agric. 1887, p. 85.]

1858

PRAIRIE FARMER, July 23, 1858, v. 18, pp. 237, 241.

A correspondent from Warren county reports that wheat is being injured by rust and chinch bug.

Item from “Polo Advertiser,” of July 15, saying that chinch bug and rust are making sad havoc with the wheat.

EMERY’S JOURNAL OF AGRICULTURE, July 22, 1858, v. 2, p. 55. Wheat, Corn, Oats, Grass, and Berries, in Egypt.

A Marion county correspondent mentions a report that the chinch bug and the Hessian fly have injured some fields of winter wheat.

PRAIRIE FARMER, July 30, 1858, v. 18, p. 249.

The “Marion County Advocate” for July, 21, reports the chinch bug as seriously damaging corn.

PRAIRIE FARMER, Aug. 13, 1858, v. 18, p. 264. The Grain Crop of 1858.

From Lee and McHenry counties, correspondents report wheat injured by rust, blight, and chinch bug.

HINKLEY, H.—Wheat Raising. Chinch Bug. (Emery’s Journal of Agriculture, Sept. 16, 1858, v. 2, p. 182.)

Last year chinch bugs not present on newly-opened prairie farms. This year they appeared in myriads just after harvest, and have attacked sorghum and destroyed second sowing of millet. They

are thick upon both sod corn and old corn. A neighbor lost several thousand strawberry plants on account of this pest [?]. Many farmers are deterred from sowing wheat lest they lose their seed. Offers to contribute one hundred dollars to a reward for a successful exterminator of the pest. Deep plowing, burning weeds and stubble, and ditches of water, useful remedial measures, but not universally applicable.

EMERY'S JOURNAL OF AGRICULTURE, Sept. 30, 1858, v. 2, p. 216.
Patent Office Seeds.

Editors state that an "original package" of "Red Tuscany Wheat" imported and distributed by the Agricultural Department of the U. S. Patent Office, on being opened in their office, was found alive with chinch bugs [Fitch's plate cited in confirmation], the wheat being bored through by these active pests [evidently weevils].

EMERY'S JOURNAL OF AGRICULTURE AND PRAIRIE FARMER, Oct. 7, 1858 [v. 2, Emery's Jour.; v. 18, Prairie Farmer], p. 228.
The Chinch Bug.

A correspondent, writing from Rockford, says that the chinch bugs have been in that vicinity for eight or nine years, doing more or less damage. Mentions some points concerning habits and life history of the pest, saying that eggs are not laid there before the middle of June [?]. Recommends clearing land of corn stalks and rubbish; plowing under, deep, small grain stubble; and rolling small grain as soon as sown and when four or five inches high. Keeps them out of corn by leaving a vacant strip of twenty-five or thirty feet between it and small grain, which he sows to corn or oats about the middle of June. This affords a hiding place and fresh food until adjacent corn is out of the way.

HINKLEY, H.—Items from Dr. Hinkley. (Prairie Farmer, Nov. 4, 1858, v. 18, p. 291.)

Heavy rain and frost have made the chinch bug scarce.

NICHOLS, O. B.—Chinch Bug. A Plan to get rid of them. (Emery's Journal of Agriculture and Prairie Farmer, Dec. 2, 1858, p. 354.)

Has sowed twenty-two crops of wheat and oats in Clinton county, and has never lost one by the chinch bug or been damaged to the amount of twenty dollars. In the fall plows under all weeds and grass that can be reached with the plow, and turns in sheep and cattle to eat out the fence corners' growth, burning over with a torch fence corners where stock cannot be allowed. Feeds all corn fodder and straw to stock, leaving nothing on the place for bugs to harbor in. Has never known them to winter in timothy or any tame hay.

1859.

THOMAS, CYRUS.—Chinch Bug. (Prairie Farmer, Jan. 27, 1859, v. 19, p. 52.)

Combats the presumption of the editor of the "Ohio Cultivator" that chinch bugs do not hibernate but die off after depositing their eggs. Recommends burning stubble, straw, and corn stalks, as being an effective measure, if Fitch is correct as to wintering habit of insect. Thinks cutting and shocking corn may afford them good winter shelter. On the other hand, he cites Fitch's quotation from the "Southern Planter," to the effect that the eggs are laid in the fall, lying in the ground till hatched by the warmth of spring.

THOMAS, CYRUS.—The Chinch Bug. (Prairie Farmer, Feb. 10, 1859, v. 19, p. 84.)

Figure of imago copied from Fitch. Short description of adult, taken chiefly from Say and Fitch, but with specimens before him, —probably Fitch's *immarginatus*.

PRAIRIE FARMER, Feb. 10, 1859, v. 19, p. 84. Chinch Bug—Other Testimony.

A correspondent confirms the then mooted point of the hibernation of the chinch bug.

PRAIRIE FARMER. RECORD OF THE SEASON.*

June 2, 1859, p. 345. *Christian Co.* Chinch bug reported as damaging wheat locally. July 14, 1859, p. 24. *Kankakee Co.* Chinch bugs quite numerous in spring wheat. July 28, 1859, pp. 56, 57. *Ford Co.* (13).† Chinch bug doing some damage in late-sown wheat, and working some on corn. No serious damage to the latter. *La Salle Co.* (16). Scarcely more than a fourth of the fields of spring wheat will be harvested, owing to chinch bugs and drouth. Aug. 4, 1859, p. 73. *Kankakee Co.* (25). Corn is being ruined in some places by chinch bugs. *Kendall Co.* (24). Protracted drouth; and wheat, oats, and corn ravaged by chinch bugs. Lime is being scattered around crops to some extent, but is not reported effective. Aug. 11, 1859, p. 88. *Ford Co.* Spring wheat, owing to drouth and chinch bugs, will not average six bushels per acre. Rain only will save the corn. Aug. 18, 1859, p. 105. *Ogle Co.* (8). Wheat and oats all cut, and good. Chinch bug destroying corn next to wheat. Very dry since May 26. Aug. 25, 1859, pp. 120, 121. The "Ogle County Reporter" gives an instance of one farmer who checked progress of chinch bugs in corn by a line of air-slaked lime. *Boone Co.* (15).

* When name of state is not given, Illinois is to be understood.

† When, in these summaries, the date of the report varies more than a week from that of the paper containing it, figures in parenthesis indicate the date of the report.

Spring wheat in town of Flora a fair crop in spite of chinch bugs and drouth. Sept. 1, 1859, p. 137. *Bureau Co.* Much chinch-bug injury to wheat and some to corn.

PETTYS, GEO.—Rats and the Chinch Bug in the Fields. (*Prairie Farmer*, July 20, 1859, v. 20, p. 50.)

Chinch bugs numerous in wheat. To protect corn sow immediately barley, other grain, or Hungarian, in five or six rows of corn next to wheat. This will detain the bugs until corn is out of their way. Cut a strip of wheat very green along the corn, set it off, and plow deep as quickly as possible. Early fall plowing a good measure.

PRAIRIE FARMER, July 28, 1859, v. 20, p. 56. Editors' memoranda.

From exchanges and the reports of correspondents, editors judge that chinch-bug ravages are extended, and that while in most cases the insects appeared too late to affect wheat seriously they are doing alarming injury to corn.

PRAIRIE FARMER, Nov. 3, 1859, v. 20, p. 277. The Use of Quails.

William Norton's testimony, as given in the "Cincinnati Artisan," cited to prove the value of the quail as an insect destroyer. In the crop of one, among other species, one hundred chinch bugs were found that "still retained their individuality," while there seemed to be hundreds more reduced to a mass.

1860.

WALSH, B. D.—[A Lecture on Insects.] (*Prairie Farmer*, Jan. 26, 1860, v. 5, n. s., p. 55.)

"The chinch bug could be destroyed by clean farming—by keeping all litter burned up clean, or placing it in a compost heap. Rain water is not relished by them."

MOORTONS, C. R.—Chinch Bugs on Wheat and Corn. (*Prairie Farmer*, March 15, 1860, v. 5, n. s., p. 161.)

Where a stalk of corn grows among grain, immediately about the stalk the grain is not injured by the bugs. When wheat is sown by the side of corn there is a strip not injured in the least [?]; hence, the following remedy for chinch bugs in wheat: Prepare the ground in fall and sow as early as possible in spring. About June 1 run furrows through the wheat ten or fifteen feet apart and drill in corn. When the wheat begins to ripen the bugs will leave the wheat and go to the corn. To keep them from corn adjacent to wheat prepare and sow thick with corn a piece of land between the two crops of sufficient size to induce them to collect in it. When this is done throw dry straw among the corn and fire it.

PRAIRIE FARMER. RECORD OF THE SEASON.

April 5, 1860, v. 5, n. s., p. 217. *Coles Co.* Little spring wheat will be sown as it is regarded as a harbor for the chinch bug. May 17, 1860, p. 313. *La Salle Co.* "No wheat sowed; chinch fly destroys it entirely." June 7, 1860, p. 360. *Iroquois Co.* Chinch bugs are ruining one piece of writer's wheat already. Never saw wheat and oats look better. June 28, 1860, p. 413. *Cook, Kankakee and DeKalb Co's.* Chinch bugs present. July 5, 1860, p. 16. *Kankakee Co.* Numerous in spring grains. July 12, 1860, p. 25. *Iroquois and Knox Co's.* In wheat. July 19, 1860, p. 41. *Marshall Co.* Injuring small grain. Wheat crop light on account of chinch bugs and drouth. Aug. 30, 1860, p. 137. *Marion Co. (Centralia).* Doing great mischief to corn.

IOWA.—July 19, 1860, p. 41. *Clark Co.* Injuring small grain. Aug. 23, 1860, p. 120. *Burlington.* Sorghum much damaged by drouth and chinch bugs.

PRAIRIE FARMER, April 12, 1860, v. 5, n. s., p. 228. Entomological Notes.

A correspondent of the "Rockford Register" keeps chinch bugs out of his corn by sowing, about June 1, a strip of Hungarian grass a rod wide between corn and all small grain. The bugs like it better than corn and will not leave it, yet do not damage it seriously for hay. Has had eight years' experience with this measure. To prevent ravages in wheat, sow early in March so that the grain will get past the milky stage before the bug commences to work in great numbers.

PRAIRIE FARMER, Sept. 6, 1860, v. 6, n. s., p. 152. Questions and Answers.

Clean farming best remedy for chinch bugs. Slaked lime may be mixed with old straw-stack bottoms when putting in compact heaps. Keep back yard tidy, stables clean, rails and fence boards picked up, and roadside free from weeds. If "strawy" manure is used, plow it under. Farmers must all adopt these precautions to have them effective.

ANDREWS, C. N.—[Extract from lecture delivered before the Winnebago Co. Agricultural Society in 1860.] (Prairie Farmer, Oct. 25, 1860, v. 6, n. s., p. 259.)

Believes that the chinch bug commences its work in small circumscribed patches, analogous to ant hills, and that by some topical application to these colonies the insects may be destroyed before they multiply and scatter. Recommends camphor and corrosive sublimate; also a strong suds made with whale-oil soap.

PRAIRIE FARMER, Nov. 22, 1860, v. 6, n. s., p. 322. Entomological Notes and Extracts.

A correspondent says that only the female survives the winter. [Erroneous.]

FITCH, ASA.—Address on our most Pernicious Insects. (Trans. N. Y. State Agric. Soc., 1859, v. 19, p. 590.)

Says the midge, the joint worm, and the chinch bug, work on the wheat crop in America to an extent unparalleled by European insects.

1861.

PRAIRIE FARMER, Feb. 21, 1861, v. 7, n. s., p. 118. Hungarian Grass vs. Chinch Bugs.

A correspondent from Kankakee county thinks that a strip of Hungarian grass ten feet wide is a sure protection to corn adjacent to infested wheat. He sowed Hungarian, thick, about the first of June, and although the bugs were very numerous and left the wheat at harvest, they did not get more than two feet into the Hungarian. [Doubtless completed development and took wing. See next item.]

PRAIRIE FARMER, Mar. 21, 1861, v. 7, n. s., p. 182. Chinch Bugs vs. Hungarian Grass.

A correspondent says that when chinch bugs prevail, Hungarian grass is as uncertain as wheat and barley and timothy and clover. Twelve acres between corn and wheat was all eaten up. [See item above.]

PRAIRIE FARMER, April 25, 1861, v. 7, n. s., p. 365. Hungarian and Bugs.

A correspondent mentioned above, under "Prairie Farmer," Feb. 21, thinks the experience given under date Mar. 21 may be due to time and manner of sowing the Hungarian—too early and not thick enough.

THOMAS, CYRUS.—Entomological Notes. No. 1. (Prairie Farmer, April 25, 1861, v. 7, n. s., p. 268.)

Incidental mention of the enormous increase of the chinch bug since the time it was unnoticed as a destructive insect, slovenly agriculture being held partly accountable for the fact.

PRAIRIE FARMER. RECORD OF THE SEASON.

Aug. 15, 1861, v. 8, n. s., p. 89. *Peoria Co.* Late-sown wheat taken by bugs. Aug. 29, 1861, p. 121. *Whiteside Co.* Chinch bugs and rust damaged wheat.

IOWA.—Aug. 15, 1861, v. 8, n. s., p. 89. *Van Buren Co.* A farmer protected his corn by pouring boiling water over every hill in the first row just as the bugs had fairly entered. Sept. 12, 1861, p. 153. *Des Moines, Henry, Jefferson, Louisa, Lucas, Monroe, and Wapello Co's.* Wheat crop injured very much by bugs and rust.

WISCONSIN.—Aug. 29, 1861, p. 121. *Rock Co.* Much wheat has been ruined by chinch bugs. Sept. 12, 1861, p. 153. *Walworth Co.* A late spring and June drouth delayed harvest and gave the chinch bugs a feast.

ILLINOIS FARMER, Aug. 1861, v. 6, p. 239. An Unofficial Look among the Farms and Nurseries.

The chinch bug ranked as a permanent enemy. From wheat stubble proceeds to corn. Constant stirring of soil best known protection to corn. Hungarian grass apparently an attractive food plant.

WALSH, B. D.—The Chinch Bug. (Insects Injurious to Vegetation in Illinois, pp. 14-17. Also published in Trans. Ill. State Agric. Soc., 1859-60, v. 4, pp. 346-349.)

Species said to be "many-brooded, like the common house fly," and to hibernate on farms about fences. Well to burn along the fences in winter. Single bug may become parent of 50,000. Plowing wheat stubble as soon as crop is cut recommended. Four coccinellids said to prey upon it. Dry weather favorable and wet weather unfavorable to it.

1862.

PRAIRIE FARMER, Feb. 1, 1862, v. 9, n. s., p. 68.

Statement that chinch-bug ravages may be prevented by sowing wheat early.

HUFFMAN, G. R.—That Coffee in Effingham County. (Prairie Farmer, Feb. 1, 1862, v. 9, p. 65.)

Incidental mention: "The army worms were gone * * * but the ground was covered with chinch bugs." They went into corn.

PHELPS, WILSON.—Rye with Wheat, for Chinch Bugs. (Prairie Farmer, April 19, 1862, v. 9, p. 241.)

Reports that a friend saved his wheat from the chinch bugs by sowing rye with it.

PRAIRIE FARMER. RECORD OF THE SEASON.

June 14, 1862, v. 9, n. s., p. 377. *South Pass, Union Co.* "The fly is injuring many [wheat] fields seriously, and in some instances the chinch bugs appear in the same fields." July 5, 1862, p. 9. *Christian Co.* Some complaint of chinch bug in spring wheat. July 12, 1862, p. 25. *Hancock Co. (Warsaw).* Spring wheat will not be worth cutting.* July 26, 1862, pp. 52, 57. *Macon Co.* Large pieces of fall wheat were turned under because of chinch-bug attack and put into corn ("which the chinch bug will take"), and other pieces have been plowed up for corn next year.

* When cause of damage to crop is not specially mentioned, the chinch bug was definitely reported as the cause.

Henry Co. Spring wet and cold; June wet and dry by turns; July alternately wet and hot. Wheat, in consequence, so weakened by rust and scab or spot, that chinch bugs and other insects, with blight and smut, will greatly reduce crop. *Warren Co.* Has heard of but one piece of spring wheat not infested by the chinch bug. A great deal will be uncut, being entirely taken by bug and fly. The chinch bug appears in wheat on new ground never before cropped. Aug. 9, 1862, p. 89. *Carroll Co.* [July 30]. Wheat damaged considerably in the past week or two. Aug. 16, 1862, p. 105. *Mercer Co.* Early-sown wheat fair where the chinch bug did not destroy it. *Stark Co.* Wheat was much injured, and corn attacked in some localities.

IOWA.—July 5, 1862, p. 9. *Van Buren Co.* Most of the spring wheat eaten up by chinch bugs. Aug. 2, 1862, p. 73. *Jefferson Co.* Spring wheat destroyed. *Van Buren Co.* Chinch bugs mostly destroyed in corn by heavy rains. Aug. 23, 1862, p. 121. Much injured wheat in central part of State. Oct. 4, 1862, p. 217. *Fayette Co.* Wheat light on account of chinch-bug ravages.

PRAIRIE FARMER, June 14, 1862, v. 9, n. s., p. 376. Wheat Prospects.

"We have before us reports from more than twenty counties in this State and Iowa, giving alarming accounts of the ravages of the Hessian fly and chinch bug. Many fields are being plowed up and planted to other crops, and a large number of acres not so treated will be left uncut."

1863.

PRAIRIE FARMER, Feb. 28, 1863, v. 11, n. s., p. 135. Questions and Answers.

"We have been sadly afflicted the past year with chinch bugs. * * * In cutting some hickories in my field I found these same bugs thirty and forty feet up the trees, under the bark and in the season cracks."

WALSH, B. D.—Hessian Flies and Chinch Bugs. (Prairie Farmer, Mar. 28, 1863, v. 11, n. s., p. 196.)

To a correspondent's question as to whether bugs found in hickory bark thirty or forty feet up the trees were genuine chinch bugs, he replies that they were probably an insect which resembles that bug. Point cannot be determined without examination of specimens. Mentions the usual hibernating places of the chinch bug in Northern Illinois, but says he has occasionally found them in moss upon trees.

PRAIRIE FARMER, Apr. 11, 1863, v. 11, n. s., p. 226. The Chinch Bug.

Last year, finding that chinch bugs were likely to ruin his wheat, Mr. Michael Hopps, of Lyonsville, Cook Co., remembering

that in the old country he had frequently rid plants of insects by the use of gas lime, decided to try it on the chinch bugs, and, purchasing a wagon load, sowed it broadcast on the wheat, six to seven bushels per acre. The bugs left immediately and his wheat was saved, while that of his neighbors was nearly ruined. He also completely protected a corn field which was adjacent to infested wheat by dropping a handful of the gas lime on each hill.

PRAIRIE FARMER. RECORD OF THE SEASON.

May 30, 1863, v. 11, n. s., pp. 345, 352. *Iroquois* (19) and *Winnebago* (20) Co's. Chinch bugs very numerous. June 6, 1863, p. 361. *La Salle* Co. Chinch-bug depredation commencing. June 20, 1863, p. 393. *Champaign* Co. Wheat and oats looking well, but chinch bugs are appearing and seem likely to ruin spring wheat, as they have, the most of it, for the last four years. July 11, 1863, p. 25. *Bureau* Co. (June 29). Some pieces of spring wheat damaged. *Hancock* Co. Spring wheat nearly ruined by drouth and chinch bugs. *Warren* Co. Wheat injured. July 18, 1863, p. 41. *Henry*, *Logan* (9), and *Piatt* (7) Co's. Some chinch bugs in wheat, but little injury as yet. July 25, 1863, p. 57. *Champaign* Co. At work in sugar cane and millet. *Marshall* and *Winnebago* Co's. Spring wheat nearly a failure; partly due to drouth in the last-named county. Aug. 1, 1863, pp. 69, 73. *Carroll* Co. (July 21). Spring wheat on poor land injured. *La Salle* Co. (July 5). Making dreadful depredations. *Bureau* Co. (July 20). Much wheat seriously injured. *Marshall* Co. Sorghum injured generally. Aug. 8, 1863, p. 89. *Fulton* Co. (July 18). Some complaint of chinch bugs in wheat. *Warren* Co. Wheat much injured. Aug. 22, 1863, p. 117. *Bureau* Co. Near the timber and on old land the chinch bug has done much damage. Sept. 12, 1863, p. 165. *Carroll* Co. Many pieces of spring wheat were taken by the chinch bug. Sept. 19, 1863, p. 192. *Will* Co. Sorghum nearly a failure on account of chinch bugs, drouth, and frost.

IOWA.—May 2, 1863, p. 281. *Jackson* Co. (April 24). Spring wheat almost a failure last year because of Hessian fly and chinch bug. May 30, 1863, p. 345. *Cedar* Co. Chinch bug reported to be infesting some wheat fields. June 13, 1863, p. 377. *Linn* Co. (4). Wheat and corn injured. Aug. 1, 1863, p. 69. *Cedar* (July 19), *Delaware*, and *Jackson* (July 10) Co's. Some grain fields damaged. Aug. 17, 1863, p. 112. *Buchanan* Co. (2). Some pieces of corn entirely devoured. *Iowa* Co. "Corn and sorghum are full of chinch bugs, even to the top." Some late wheat injured. Sept. 5, 1863, p. 149. *Taylor* Co. (Aug. 19). Wheat injured.

MISSOURI.—Aug. 8, 1863, p. 89. *Lewis* Co. (July 29). Chinch bugs were plenty, but have all disappeared. Completely devoured large patches of sugar cane.

WISCONSIN.—June 6, 1863, p. 361. *Doane* Co. Some complaint of chinch bug in barley and early wheat. June 27, 1863, p. 409. *Rock* Co. (14). Appearing in large numbers. July 18,

1863, p. 41. *Rock Co.* Weather dry and chinch bugs seriously injuring the wheat. Aug. 22, 1863, p. 117. *La Crosse Co.* (12). Spring wheat injured.

WILSON, WM. DUANE.—*Iowa Farmers' College, Crops, etc.* (*Prairie Farmer*, July 4, 1863, v. 12, n. s., p. 4.)

Writing from Des Moines, says that owing to the lack of rain and to chinch bugs the prospect for wheat is poor.

F., L. F.—*Jo Daviess County. Condition of Crops, Insect Foes, Winter Wheat, etc.* (*Prairie Farmer*, Aug. 22, 1863, v. 12, n. s., p. 114.)

Says wheat crop will range from five to thirty bushels per acre, the unusual variation being due to the chinch bug.

ILLINOIS FARMER, Aug., 1863, v. 8, p. 247. The Way to Prevent the Ravages of the Chintz Bug. (Quotation from "*Bureau County Republican*" with editorial comment.)

The writer of the quoted article thinks chinch bugs are due to the poverty of the soil, as lice on cattle indicate half feeding. In the field of a thrifty experimenting farmer he thought he saw demonstration that heavy manuring and plowing in August saved wheat from the chinch bugs and secured a good crop, since a part of the same field plowed at the same time but not manured bore poor wheat and little of it. Advises farmers to plow in August or early September. The editor of the "*Illinois Farmer*" grants that good culture is a remedy for the chinch bug, but emphasizes early sowing as a means of getting the crop out of the insect's way. Thinks that in the field referred to, the manure may have been put on the drier, better drained part, where the wheat, of course, matured rapidly, and was deserted by the bugs in favor of the greener, more succulent grain adjoining. Thinks that in a wet season manure, by promoting heavy growth of straw, might prove more disastrous to the crop than the chinch bugs, since between lodging and rust it must succumb entirely." Endorses August plowing. Proper soil, early and thick seeding, and thorough harrowing and rolling, he considers effectual against material chinch-bug damage to spring wheat.

GOODSIL, CURTIS.—*Crops in McHenry County.* (*Prairie Farmer*, Sept. 12, 1863, v. 12, n. s., p. 163.)

Reports winter rye "injured by chinch bugs, and spring wheat but half a crop." Says, "I observed portions of several fields which had been manured, where chinch bugs did no damage, and a heavy crop of good quality was the result."

FITCH, ASA.—*A Brief Account of the most Important Injurious Insects of the United States.* (From *Illustrated Annual of Rural Affairs.*)

Among insects injurious to grain crops mentions the chinch bug. [Not seen. See 1st Rept. State Ent., N. Y., p. 316.]

1864.

PRAIRIE FARMER. RECORD OF THE SEASON.

June 25, 1864, v. 13, n. s., p. 443. *Henry Co.* Reported bad in wheat. Never before appeared so early. *Marshall Co.* (15). Numerous. July 2, 1864, p. 5. *Bureau Co.* (June 22). Spring wheat nearly or quite ruined in some sections of the county. *Knox Co.* Likely to destroy most of the wheat, and in oats to some extent. Came very early and are very numerous. July 9, 1864, p. 21. *Carroll Co.* (June 28). Wheat thin and badly infested. *DeKalb Co.* (June 30). Barley much hurt and wheat damaged. *Mercer Co.* (June 28). Likely to destroy spring wheat. *Woodford Co.* (June 30). Wheat, oats, and barley are being killed. July 16, 1864, p. 37. *Carroll Co.* Corn, oats, and wheat damaged. *Hancock Co.* (6). Chinch bugs very numerous. *Henry Co.* Spring wheat more than half destroyed. *Livingston Co.* (6). Oats and wheat nearly ruined by drouth and chinch bugs. *Putnam Co.* (7). Taking everything. *Warren Co.* More numerous and destructive than ever before. *Will Co.* Wheat, oats, and barley are being ruined. July 23, 1864, p. 60. *DeKalb Co.* Hundreds of acres of barley and wheat are being burned on the ground to destroy the bugs. *La Salle Co.* (10). The wheat is destroyed, and oats and corn are likely to suffer. *Lee Co.* (June 25). Some complaint of chinch bug. *Stephenson Co.* (12). Wheat ruined, and corn and oats being taken. July 30, 1864, p. 69. *Henry* (20) and *Lee* (25) *Co.*'s. Very destructive to wheat, and now on corn or going to it. *McHenry Co.* (18). Wheat, rye, barley, and late oats a failure, and corn threatened. Early in season found extensive deposits of chinch-bug eggs on roots of grain. *McLean Co.* (11). Spring wheat almost entirely ruined. *Schuyler Co.* (18). Wheat (especially spring), oats, and barley are injured, and corn is being damaged. *Vermilion Co.* (15). Some pieces of spring wheat infested, and may be injured. *Will Co.* (20). Rained in time to save most of wheat and oats. Aug. 13, 1864, p. 10. *McDonough* and *Tazewell Co.*'s. Have done little damage. *Rock Island Co.* Much injury; more to barley than to wheat. Aug. 20, 1864, p. 117. *Schuyler Co.* (9). Killed late oats and are now in the corn. Aug. 27, 1864, p. 132. *Effingham Co.* (6). "Chinch bugs not as bad as usual. We feed them (on Hungarian) until they kill themselves. The middle of July we could gather up the dead [cast skins?] by the double handful." Sept. 3, 1864, p. 149. *Lee Co.* (Aug. 22). Injury to corn less than supposed.

IOWA.—June 25, 1864, p. 443. *Cedar Co.* (13). Destroying much wheat. *Clayton Co.* At work in barley and wheat. July 23, 1864, p. 60. *Cedar Co.* (13). More destructive in certain sections of the county than ever before. Much wheat destroyed, and fears entertained for corn. *Jones Co.* (8). "There are enough chinch bugs in the wheat, as a general thing, to eat it bodily. As bad on new land as on old. Also in oats." Aug. 6, 1864, p. 85. *North-*

ern Iowa (July 28). Wheat, corn, sugar cane, and Hungarian are infested; the latter not yet injured. *Delaware Co.* (July 25). Some of the wheat is considerably damaged. Aug. 13, 1864, p. 10. *Decatur Co.* (July 30). Wheat, oats, sorghum, and corn injured. *Iowa Co.* (Aug. 5). Wheat and sorghum much injured.

MISSOURI.—June 11, 1864, p. 414. *Lewis Co.* (May 18). Destroying a field of barley. Do not touch oats adjoining. All are adults. Earlier by a month than they have ever appeared before. July 23, 1864, p. 60. *Caldwell Co.* (4). Oats ruined by drouth and chinch bugs. Little wheat sown last fall, but that is generally good.

NEBRASKA.—June 25, 1864, p. 443. *Otoe Co.* (14). "Drouth and chinch bugs threaten entire ruin to wheat."

WISCONSIN.—July 16, 1864, p. 37. *La Fayette Co.* Very numerous. Contrary to the general experience heretofore, depredations are most severe on new ground and in early-sown wheat. Now in oats and corn. Aug. 6, 1864, p. 85. *Fond du Lac Co.* (17). Wheat almost ruined. Aug. 20, 1864, p. 117. *Dane Co.* Have done more damage lately than the drouth. Aug. 27, 1864, p. 132. *Dane Co.* Some corn injured. *Grant Co.* Some wheat injured.

BUDD, JOSEPH L.—Chinch Bugs. The Best Way to manage them. (Prairie Farmer, July 16, 1864, v. 14, n. s., p. 36.)

States that chinch bugs have made wheat-growing precarious in the Cedar Valley [Iowa]. Advocates early sowing and thick seeding, plowing early in fall, and rolling the ground. Has by these means obtained fair crops when land worked in the old way yielded nothing. He adds, "Mr. S. G. Livermore, of this county [Benton], assures me that a certain plot of land, manured three years since, has produced good crops of wheat, not especially molested by bugs, while adjoining wheat, sown at the same time with the same cultivation, was barely worth cutting."

PRAIRIE FARMER, July 16, 1864, v. 14, n. s., p. 40. The Chinch Bug.

Editorial on the chinch-bug situation. States that wheat, oats, and barley, in Northern Illinois and Wisconsin have been badly damaged, and fears are expressed for corn and sorghum. Bugs first appear in spring wheat. Abandonment of that crop suggested.

PRAIRIE FARMER, July 23, 1864, v. 14, n. s., p. 52. Another Word about Chinch Bugs. How to use them.

From Cedar Co., Iowa, "Agricola" writes that early fall plowing and early and thick sowing, as advocated by J. L. Budd [see above], are ineffectual as a chinch-bug remedy in his county. Advocates deep sowing and compact ground. Says, "Wheat sown in February, this season, in this vicinity, has been entirely destroyed by the bug."

PRAIRIE FARMER, July 23, 1864, v. 14, n. s., p. 56.

Editorial note calling attention to proper spelling of the name. Said to be frequently spelled chintz, by exchanges. The rains in chinch-bug region will probably check the pest.

COUNTRY GENTLEMAN, July 28, 1864, v. 24, p. 65.

Reprint of an item from the "Rockford Register," which reports the successful use of boards set on a ridge made by plowing double furrows along side of field, upper edge of boards being saturated with kerosene. Bugs did not cross.

FOSTER, SUEL.—The Chinch Bug Destroying the Wheat in Iowa. (Country Gentleman, July 28, 1864, v. 24, p. 58.)

Writes from Muscatine, Iowa, July 14, 1864, of great damage by bugs in Eastern and Central Iowa. Winter wheat badly winter-killed, and spring wheat over half destroyed by bugs. Young red bugs found about roots. Says, "We must quit growing spring wheat in the West, until we get rid of the chinch bug." Much corn injured.

PRAIRIE FARMER, July 30, 1864, v. 14, n. s., p. 69. [Editorial review of circular issued by Geo. R. Chittenden, concerning crop prospects.]

ILLINOIS.—Counties reporting chinch-bug injury—"principally in spring wheat"—are Bond, Boone, Christian, Henry, Iroquois, Jefferson, Knox, La Salle, Livingston, McLean, Marshall, Ogle, Peoria, Stephenson, Whiteside, Woodford. IOWA.—Counties infested are Black Hawk, Bremer, Cedar, Chickasaw, Clayton, Dubuque, Elkador, Jones, Keokuk, Linn, Muscatine, Poweshiek. WISCONSIN.—The following counties report damage by chinch bugs: Columbia, Crawford, Dodge, Grant, Green, La Fayette, Racine, Sauk, Walworth, and Waukesha, the damage being estimated from considerable to almost an entire failure of crop. Oats and barley are severely injured, and corn frequently attacked.

BUDD, JAS. [JOS.] L.—Chinch Bug. Objection to Deep Covering of Spring Wheat. (Prairie Farmer, Aug. 6, 1864; v. 14, n. s., p. 84.)

Replying to "Agricola" [see previous page], reiterates belief in efficacy of sowing spring wheat early and thick. Suggests raising winter wheat instead, on account of its being a surer crop.

PRAIRIE FARMER, Sept. 10, 1864, v. 14, n. s., p. 164. Chinch Bugs—Birds.

A correspondent mentions the appearance of chinch bugs in wheat on sod, but not in numbers to do serious damage. Thousands of birds about when seed was sown, but they were after the wheat, and necessitated the sowing of some land twice.

PRAIRIE FARMER, Sept. 10, 1864, v. 14, n. s., p. 164. Game and Insectivorous Birds.

A contributor says that "the quail is perhaps the only bird that will destroy the chinch bug to any great extent."

PRAIRIE FARMER, Nov. 12, 1864, v. 14, n. s., pp. 306, 307. The Rockford Convention.

In report to the Sorghum Growers' Convention, J. M. Frink said that the chinch bug had materially injured sorghum in his vicinity [McHenry Co., Ill.]. Mr. Seward objected to White Im-pee variety, because chinch bugs seemed to be more fond of it than of ordinary cane. E. W. Skinner, Madison, Wis., reported serious injury from chinch bugs this year [1864], and mentioned tarred boards as a successful barrier to their progress. Said gas tar would answer equally well.

PRAIRIE FARMER, Nov. 12, 1864, v. 14, n. s., p. 312.

A subscriber [address not given] states that chinch bugs were worst in corn-stalk ground plowed in spring.

1865.

MOSS, A.—(Country Gentleman, Jan. 12, 1865, v. 25, p. 36.)

Writing from Boone county, reports many fields of corn largely reduced. .

PRAIRIE FARMER. RECORD OF THE SEASON.

April 1, 1865, v. 15, n. s., p. 233. *Marshall Co.* In one township yield of wheat reduced last year to seven or eight bushels per acre. *Stark Co.* Less wheat than usual will be sown on account of chinch bugs. April 22, 1865, v. 15, n. s., p. 304. *Henry Co.* "If this is a wet season, as we expect, we shall hope to get rid of the chinch bug." *McHenry Co.* Less wheat sown than heretofore on account of dread of chinch bug. May 6, 1865, p. 354. *Henderson Co.* Presence of the chinch bug incidentally mentioned. May 13, 1865, p. 373. *McLean Co.* Some chinch bugs visible. May 20, 1865, p. 400. *Bureau Co.* The "Republican" says the air was full of chinch bugs on Friday last. May 27, 1865, p. 417. *Tazewell Co.* Little wheat sown on account of chinch bugs. *Whiteside Co.* (16). Have made their appearance. June 17, 1865, pp. 484, 485. Editors note that the chinch bug, which was rapidly multiplying and in many places doing serious damage, has probably been checked by recent rains. *La Salle Co.* (May 30). Whole fields of corn destroyed in some places. *Stark Co.* (June 4). Chinch bugs appearing in large numbers. *Winnebago Co.* (June 7). "Chinch bugs have killed out what little wheat the farmers did sow." *Woodford Co.* (6). Some small grain plowed up because of injury by the chinch bug. June 24, 1865, pp. 504, 505. *Effingham Co.* (12). Wheat infested. *Henry Co.* (12). Very numerous and attacking all kinds

of grain. Some are plowing up their wheat and planting corn. *La Salle Co.* (16). Appeared in great numbers three weeks ago, and there are now myriads of young ones in wheat and corn, the latter crop suffering most. *Lee Co.* (16). Spring wheat infested; but little injury yet. *Warren Co.* (15). Young corn and other tender crops injured somewhat. July 1, 1865, p. 528. *Carroll Co.* Spring wheat full of quite young chinch bugs. The bug breeds in barley as in wheat, but is never found in rye or oats [?]. *Marion Co.* Wheat crop will probably be reduced one half on account of rust and chinch bugs. July 8, 1865, p. 4. *Bureau Co.* Unusually numerous for the season. Have considerably damaged wheat, oats, and barley. Rain is checking them. *Kendall Co.* (June 30). "Plenty in many places. My wheat will hardly be worth cutting unless rain stops them." *Putnam Co.* (June 28). Wheat attacked. July 15, 1865, pp. 24, 25. *Fulton Co.* (8). Much wheat ruined. Corn adjoining wheat and rye much damaged. Chinch bugs most numerous in wheat following infested corn. Recommends sowing strip of oats four rods wide between corn and wheat. July 11, from another correspondent: "Wheat has suffered more from ravages of chinch bug than in any previous season." *Henry Co.* Destructive in several sections of the county. *McHenry Co.* (6). Chinch bug has appeared in some fields, but has not "commenced as savage" as in 1864. July 10, from another correspondent: More numerous than ever before. In all kinds of grain. Wheat likely to be a total failure. "Bugs are now attacking corn in solid phalanx." *Stephenson Co.* Spring wheat injured early by drouth, and later by chinch bug and grub. *Wabash Co.* (June 11). Wheat poor, and by some the fact is attributed to the chinch bug. *Young America, — Co.* Wheat somewhat injured. July 22, 1865, p. 44. *Cass Co.* Fall wheat good, but spring wheat much injured. Bugs now on the corn. *Macoupin Co.* (10). Wheat nearly a failure, owing to winter-killing, rain, rust, and the chinch bug. *Tazewell Co.* Wheat has suffered, and bugs have migrated to corn adjoining wheat. *Winnebago Co.* Spring wheat is being injured with the exception of a very early variety. July 29, 1865, p. 69. *Bureau Co.* (21). Wet, cool weather has checked the chinch bug. *Cook Co.* Wheat and barley, half a crop—injured by chinch bug. *Putnam Co.* (21). "Corn doing well except where attacked by chinch bug." Aug. 5, 1865, p. 88, *Kankakee Co.* (July 27). Not more than half a crop of wheat, owing to chinch bugs, rust, and blight. Aug. 12, 1865, p. 108. *Marshall Co.* (July 31). "No depredations, though the chinch bug made its appearance before the wet weather set in." Aug. 26, 1865, p. 145. *Marion Co.* Spring wheat much injured.

IOWA.—May 6, 1865, p. 352. *Adair Co.* (Apr. 22). "But little wheat sown, partly on account of chinch bugs, and partly on account of the general opinion that this will be a wet year." July 22, 1865, p. 44. *Iowa Co.* Chinch bugs numerous. Aug. 12, 1865, p. 108. *Madison Co.* (July 31). Wheat somewhat injured by chinch bug and "scab." Aug. 26, 1865, p. 144. *Cedar Co.* (14). Many wheat fields ruined.

MINNESOTA.—July 1, 1865, p. 528. *Wabasha Co.* (June 19). Crops look well, and farmers anticipate a heavy growth of straw, if the chinch bug does not destroy it. July 8, 1865, p. 4. *Rice Co.* (June 27). "The chinch bug is busy, but has, as yet, done little damage." Aug. 5, 1865, p. 89. *Goodhue Co.* (July 24). "Wet weather seems to have disposed of the chinch bugs that last year appeared here in considerable numbers."

MISSOURI.—July 29, 1865, p. 69. *Clark Co.* "Rains have stopped the work of the chinch bugs."

WISCONSIN.—July 1, 1865, p. 528. *Dane Co.* A few chinch bugs about. *La Fayette Co.* "Here in full force, as usual. Not doing much harm just now." July 15, 1865, p. 25. Editorial mention of great damage to crops generally in 1864, by chinch bug and drouth. July 29, 1865, p. 69. *Columbia Co.* Drouth shortened the growth of spring wheat and gave chinch bugs a strong hold. *Fond du Lac Co.* Some pieces of spring wheat half ruined. July 1, 1865, p. 528. Editors say, "Though we hear of chinch bugs everywhere, north, the extent of damage done by them seems comparatively slight as yet."

COUNTRY GENTLEMAN. RECORD OF THE TIMES.

July 6, 1865, v. 26, p. 20. *Rock Island Co.* (June 23). "We are much alarmed by the ravages of the chinch bug." July 13, 1865, p. 36. *Danby, ——— Co.* Wheat and barley injured somewhat.

WISCONSIN.—July 20, 1865, p. 52. *Kenosha Co.* (10). Some spring wheat damaged. Aug. 3, 1865, p. 84. *Dodge Co.* (July 21). Some fields of spring wheat are nearly ruined.

NORTON, H. B.—Chinch-Bug Fence. (*Prairie Farmer*, Apr. 29, 1865, v. 15, n. s., p. 327. Reprinted in *Valley Farmer*, June 1, 1866 [See *Pract. Ent.*, v. 1, p. 95]; also in *Pract. Ent.*, v. 1, p. 95, with note of commendation by Walsh.)

Reports saving a hundred-acre corn field in Ogle Co., Ill., in April, 1865, by use of pine boards set edgewise and coated with coal-tar. Pits were dug at intervals, into which the bugs fell, and from which they were shoveled by the wagon-load at the rate of thirty or forty bushels per day.

LAUGHTON, GEORGE R.—The Chinch Bug. (*Prairie Farmer*, June 17, 1865, v. 15, n. s., p. 483.)

Saved one acre of wheat from chinch bugs by sowing on it, June 14, one bushel of salt. Three bushels of quick lime to the acre without effect upon the bugs.

PRAIRIE FARMER, July 29, 1865, v. 16, n. s., p. 73. Trees a Protection against Insects.

In view of the fact that chinch bugs and other insects are becoming almost intolerable pests, the cultivation of belts and groves

of timber on prairie farms is recommended as a means of attracting birds, who are the most destructive natural enemies of noxious insects.

Reference to statement in the "Bloomington Pantagraph" that the wheat crop of McLean county will only average from eight to nine bushels per acre, owing to chinch-bug injury.

PRAIRIE FARMER, Sept. 9, 1865, v. 16, n. s., p. 190. The Chinch Bug. (Extract from Waukegan Gazette, also printed in Country Gentleman, Dec. 21, 1865, v. 26, p. 395.)

Prints an extract from "Waukegan Gazette," giving D. H. Sherman's theory that the eggs of the chinch bug are deposited in the "fuzzy end of the kernel," and that the insect may be easily eradicated by steeping the seed in some solution which will destroy the larva. Editorial comments [by C. V. Riley?] showing fallacy of idea, and stating that the bugs hibernate as adults.

PRAIRIE FARMER, Sept. 30, 1865, v. 16, n. s., p. 253.

Editorial note of receipt of a letter from Henry Shimer, of Mt. Carroll, to the effect that farmers need not fear chinch bugs the coming year as they have "all died of climatic epidemic disease."

PRAIRIE FARMER, Oct. 21, 1865, v. 16, n. s., p. 308. Chinch Bugs not in Seed Grain.

Report of an experiment showing that egg of chinch bug is not deposited in kernel.

PRAIRIE FARMER, Nov. 25, 1865, v. 16, n. s., pp. 384, 385 Condition of Crops—Chinch Bugs, etc.

A correspondent, address not given, thinks bugs have been killed as a result of rains. Can find no living ones. Says, "There is no great hazard in sowing a limited number of acres of spring wheat in 1866."

SHIMER, HENRY.—Description of the Imago and Larva of a New Species of *Chrysopa* [*C. illinoiensis*]. (Proc. Ent. Soc. Phila., 1865, v. 4, pp. 208-212.)

Specimens described were obtained from a field of corn (sown very thick for fodder) where the larvæ were voraciously feeding upon chinch bugs, which literally blackened every stalk of corn. Estimates that there was, in September, one or more of the *Chrysopa* larvæ for every stalk of corn. One example confined in a bottle victimized about a dozen bugs in quick succession, sucking the juice from their bodies. Nov. 29, 30, and Dec. 1, saw this and other species of *Chrysopa* flying, (the weather being quite warm after three weeks of severe cold, which froze the ground eight inches,) and thinks it probable, therefore, that the adult *Chrysopa* may live during the winter, in which case, he sees reason to hope that it will aid in suppressing the ravages of the chinch bug.

1866.

W. H.—Salt for Chinch Bugs—Lime. (Prairie Farmer, Feb. 3, 1866, v. 17, n. s., p. 67.)

Gives results of experiments with salt and lime against chinch bugs, showing that these substances have no effect.

J. G.—Salt for Chinch Bugs. (Prairie Farmer, Feb. 24, 1866, v. 17, n. s., p. 114.)

Reports experiment which demonstrates that salt applied to wheat has no influence on the bugs.

RILEY, C. V.—The Chinch Bug. (Prairie Farmer, Mar. 3, 1866, v. 17, n. s., p. 133.)

Replying to a correspondent, author discusses remedies which have been used or proposed for the ravages of the chinch bug—ditching, sowing winter grain with spring wheat, killing hibernating adults, soaking seed in brine and then liming it, sowing hemp, etc. Theory that eggs are deposited on the “fuzzy end of the kernel” (see under Prairie Farmer, Sept. 9, 1865, previous page) thoroughly exploded.

RILEY, C. V.—The Chinch Bug. (Pract. Ent., Mar. 26, 1866, v. 1, p. 47.)

Again disposes of Mr. Sherman's theory that chinch bugs deposit their eggs in the “fuzzy end of the kernel” (see previous item), giving life history of the insect as refutation of it, and also mentioning the bootless microscopic search for eggs on wheat sent him by Mr. Sherman. He adds, “Without advising farmers to discontinue steeping their grain in brine or other solutions (for they doubtless give the young plants a vigorous start) let them understand clearly, that they do not kill any chinch bugs by the operation; and they should therefore rely on the more sensible means of burning all the grass, corn stalks, weeds, etc., on and around their fields, before the ground is thawed out, and of rolling the ground when the grain is in.”

DAVIS, SOUTHWICK. — Letter from Southern Illinois. (Prairie Farmer, Mar. 31, 1866, v. 17, n. s., p. 207.)

From Hoyleton, Washington Co., Mar. 13, 1866, writes that the chinch bug is the greatest pest they have, hardly leaving them corn enough for their own use. Wheat generally out of the way before bugs are large enough to do much damage, but when it is cut they go into the corn by millions. Some protection derived by sowing early a strip of Hungarian around the corn. Some say the Hungarian kills them.

PRAIRIE FARMER. RECORD OF THE SEASON.

Apr. 21, 1866, v. 17, n. s., p. 272. *McHenry Co.* (6). “The general opinion around here is that the chinch bug has left for good.” June 16, 1866, p. 413. *Boone Co.* No signs of chinch bugs yet, although a few were found in spring about borders of

fields. *Madison Co.* (5). Chinch-bug devastation anticipated. No positive indications. July 14, 1866, p. 25. *Champaign, Henry, and McHenry Co's.* No complaint of chinch bugs; and in the last two counties there seem to be none. *Randolph Co.* "Corn backward and bugs forward."

WALSH, B. D.—Answers to Correspondents. (*Pract. Ent.*, May 28, 1866, v. 1, p. 77.)

Incidental mention of some points in life history in reply to a correspondent who sent another species supposed to produce the chinch bug.

WALSH, B. D.—Answers to Correspondents. (*Pract. Ent.*, June 25, 1866, v. 1, n. s., p. 89.)

Comparison instituted between the chinch bug and an insect belonging to the same family sent by correspondent for name.

WALSH, B. D.—Answers to Correspondents. (*Pract. Ent.*, Nov., 1866, v. 2, p. 21.)

Replying to J. Pettit, C. W., who sent specimens of chinch bugs, Mr. Walsh states that they "differ remarkably from our specimens by the wings being only half as long as the abdomen." Infers that they are a geographical variety. Species not before known in Canada. Says, "As the insect is more peculiarly a southern species, I do not apprehend that it is likely ever to swarm with you, as it often does in the West; and at all events, having such short wings, it will not be able in Canada to fly in swarms from one locality to another as our little pest occasionally does."

CANADA FARMER, Dec. 1, 1866. The Chinch Bug.

Mentions hibernation of the chinch bug at Grimsby, Ontario, and gives account of habits and seasons. Quotes *Prairie Farmer* for remedies. (Not seen. See Howard's *Bibliographical List*, Rept. [U. S.] *Commiss. Agric.*, 1887, p. 85.)

1867.

SHIMER, HENRY.—Notes on *Micropus (Lygaeus) leucopterus*, Say, ("The Chinch Bug"). With an Account of the Great Epidemic Disease of 1865 among Insects. (*Proc. Acad. Nat. Sci. Phila.*, 1867, v. 19, pp. 75-80; and *Trans. Northern Ill. Hort. Soc.*, 1867-68, pp. 97-101.)

Writing from Mount Carroll, Ill., gives detailed account of observations during 1864 and 1865, stating that in the Mississippi Valley the insect reached the maximum of its development in 1864, the loss by its ravages that year being estimated at more than \$100,000,000 in the currency prevailing at the time. Has seen columns of the insect a full week on the march across grass to corn, in one instance even swimming a small stream. In 1864, whole corn fields were overrun by them, the stalks being literally raw from their punctures. When the perfect insects began to fly

many believed that they were leaving the country; but it was simply their mating season—the only time (twice a year) at which they take the wing. Notes the fact that the cast skins of the insect are often mistaken for dead bugs. Two insect enemies are mentioned,—*Hippodamia maculata* (a common species of “lady bird”) and *Chrysopa illinoiensis* (a species of the “golden-eyed fly”). These insects were very numerous,—especially the former, which could be counted by hundreds on every square yard of ground after shaking the corn,—but they made very little impression on the chinch bugs. Found chinch bugs alive under snow after several days of a temperature 15° or 20° below zero, but dead if above the snow. In frozen corn husks they will live at a temperature below the freezing point, and perhaps below zero. In March and April, 1865, found a large majority of the hibernating bugs alive. May 18 and 19, abundant in spring wheat, barley, etc. Eggs laid latter part of this month, mostly on roots and stalks beneath the ground. First larvæ of the season seen June 10; millions of young bugs June 17, when parent bugs were principally dead. “July 16. Found many chinch bugs dying in the low creek-bottom land from the effect of some disease, while yet in the larval state. July 22. On low ground young chinch bugs all dead from the disease, and it is spreading rapidly on the hills and high prairies. Weather wet since first of July. July 28. Great numbers in all stages of their development are dying of the prevailing disease. Aug. 22. It is almost impossible to find even a few cabinet specimens of chinch bugs alive.” Says that the parent chinch bug is about twenty days in laying about five hundred eggs, and then dies, the imago appearing in from fifty-seven to sixty days after the egg is laid; and that there are two distinct broods in a season, and only two. The disease alluded to was associated with long-continued wet and cloudy cool weather, and was no doubt in some measure due to it. No attempt to define the direct cause. The disease was not confined to the chinch bug. Considers it proven “that epidemic diseases are *incomparably the most* important agents in all nature in destroying noxious insects.” Very difficult to find any chinch bugs in 1866.

SHIMER, HENRY.—Additional Note on the Chinch Bug. (Proc. Acad. Nat. Sci. Phila., 1867, v. 19, p. 234.)

Mt. Carroll, Ill., Sept. 16, 1867. “The chinch bug has entirely disappeared from this region, so far as I have been able to observe. Efficient cause, the continuation of the epidemic among them.”

1868.

PRAIRIE FARMER, May 9, 1868, v. 21, n. s. p. 297. Birds *vs.* Insects.

In this article (probably editorial) Dr. Henry Shimer is credited with the following statement: “One hundred chinch bugs have been found in the crop of a quail, when shot, and, in a season,

100,000 would not be an over-estimate of the number that a single quail might destroy in a good chinch-bug year—enough to give 500,000,000 chinch bugs if allowed to reproduce at their natural rate.”

PACKARD, A. S., JR.—Entomological Calendar. (Am. Naturalist, June, 1868, v. 2, p. 221.)

General assertion that the chinch bug appears in wheat fields in June.

CLARKE, J. W.—Our Wisconsin Correspondence. (Cultivator and Country Gentleman, July 23, 1868, v. 32, p. 61.)

The chinch bug has spread rapidly, and is spotting the field with dead wheat.

J[OHNSON], B. F.—Our Illinois Correspondence. (Cultivator and Country Gentleman, July 23, 1868, v. 32, p. 61.)

Chinch bugs in corn, giving it a whitish appearance, called the “scab.”

PRAIRIE FARMER. RECORD OF THE SEASON.

July 25, 1868, v. 39, pp. 26, 32. *Champaign Co.* Much spring wheat already destroyed, especially the late-sown. *Clinton Co.* Wheat almost a failure; corn suffering. *Douglas Co.* Winter wheat good; spring wheat badly injured; and corn likely to be damaged. *Effingham Co.* “Chinch bugs are plenty.” *Jackson Co.* Some fields of wheat nearly ruined. Aug. 15, 1868, p. 56. *Clinton Co.* (1). Wheat, oats, and corn much injured. Young chinch bugs hatching by the million. Sept. 5, 1868, p. 80. *Edgar Co.* Spring wheat a failure; three fifths of it not harvested. Many attribute the failure to drouth and chinch bugs. Remembering the damage done in this section in 1860, farmers are likely to abandon the sowing of spring wheat and Hungarian. Corn promises well. *Shelby Co.* Winter wheat good; but spring wheat a failure on account of chinch bugs and hot weather. Sept. 19, 1868, p. 96. *Monroe Co.* (10). Much injury from chinch bugs and drouth. *Randolph Co.* (3). On account of successive drouths and the ravages of the chinch bug, corn raising is nearly abandoned, and winter wheat is the principal crop. Sept. 26, 1868, p. 104. *Clinton Co.* A good deal of the corn will be “light and chaffy” on account of injury by the chinch bug. Oct. 10, 1868, p. 120. *Effingham Co.* “The chinch bug has been at work on our corn since the first of July.”

1869.

WALSH AND RILEY.—The Chinch Bug. (*Micropus leucopterus*, Say.) (Am. Ent., May and June, 1869, v. 1, pp. 169-177, 194-199.)

An elaborate article treating of its past history, natural history, natural checks upon multiplication, effect of rains upon it, prophecies concerning it, insects mistaken for it, damage done by it, and remedies. Good synopsis of history in Illinois. Believed to be a

native insect there. Kept down in former times by prairie fires. Anticipate increase until abandonment of wheat culture for a term of years becomes necessary. Two-brooded in Northern Illinois, but possibly three, or even four, broods farther south. Calculate that two thousand chinch bugs, hibernating successfully, may give origin to two thousand millions the following year. Authors believe that flights are due to scarcity of food, and mention observations opposed to theory that they are taken for pairing purposes. Advise plowing wheat land in fall and rolling repeatedly after seeding in spring, to prevent access of female to roots. First damage, and greatest, on dry land. Mention and figure of short-winged Canada form. Authors ridicule Dr. Shimer's theory of an epidemic disease, and attribute destruction to immediate effect of wet weather. Estimate damage by chinch bug in Illinois in 1864 at over seventy-three millions of dollars. Under head of remedies, discuss burning of winter shelter, scattering straw upon infested wheat and burning in spring, burning injured wheat at harvest, mixing spring wheat and winter rye, arresting movement by coal-tar barriers, and the application of gas lime to infested fields. Under "Recapitulation," four points are mentioned as important and well established: (1) Chinch bugs hibernate as adults in rubbish, old straw, corn stalks, under dead leaves, among weeds in fence corners, etc., therefore such substances should be burned in spring. (2) The earlier in spring small grain is sowed the more likely it will be to escape the chinch bug. (3) The harder the ground where grain is sowed, the less chance for chinch bug to penetrate to the roots for deposition of eggs, hence the importance of fall plowing, and rolling. (4) A single heavy rain immediately checks propagation of chinch bugs; continued heavy rains diminish their numbers materially; and a long-continued wet season barely leaves enough for seed another year. The insect is never ruinously destructive except in sections where there is continued hot dry weather.

A. A.—Rain as an Insect Destroyer. (Prairie Farmer, July 3, 1869.)

Writing from Boone Co., correspondent says that in July, 1886, the chinch bugs, while migrating from one field to another, were destroyed by a long cold rain, and he has heard of no damage by them there since.

AMERICAN ENTOMOLOGIST, Nov., 1869, v. 2, p. 51. Entomological Jottings. Chinch Bugs.

From St. Clair Co., June 5, 1869, Col. Fred. Hecker writes that heavy rains from the 30th of May to the 4th of June "operated splendidly" upon the chinch bugs. A few days before the rains all the wheat roots, when examined, seemed alive with the bugs. Refers to loss of three acres of corn in 1868 "in spite of plowing and ditching."

1870.

REPORT [U. S.] COMMISSIONER OF AGRICULTURE, 1869, p. 537.
State Reports on Agriculture. Wisconsin.

"Wheat, so long the leading crop of the State, has hardly lost its prestige. * * * The ravages of its enemy, the chinch bug (*Micropus leucopterus* of Say), were extensive in 1864, 1865, and 1866, but the extremely cold winters that succeeded, or other natural causes, have nearly exterminated it."

LEBARON, WM.—Do Birds do more Harm than Good? (Prairie Farmer, March 12, 1870, v. 41, p. 74.)

"The hairy caterpillars are eaten by very few birds; and the nauseous Hemiptera, such as the squash bug (*Coreus*) and the chinch bug, are, I believe, rejected by all."

CLARKE, J. W.—A Chinch Bug Destroyer. (Prairie Farmer, Apr. 9, 1870.)

From personal observation, is quite confident that the "red-headed [winged ?] blackbird" destroys many chinch bugs.

PRAIRIE FARMER. RECORD OF THE SEASON.

June 4, 1870, p. 176. *Douglas Co.* Chinch bugs said to be at work on wheat and oats. July 9, 1870, p. 216. *Logan Co.* Wheat much injured. Aug. 6, 1870, p. 248. *Champaign Co.* Winter wheat good, but spring wheat much injured. Oct. 22, 1870, p. 336. *McLean Co.* Corn heavy where the chinch bugs have not injured it. Small grain light.

MISSOURI. July 16, 1870, p. 224. *Worth Co.* (4). Chinch bugs have damaged wheat. Oct. 22, 1870, p. 336. *Livingson Co.* (10). Dry weather and chinch bugs have injured the corn.

J[OHNSON], B. F.—[Letters from Champaign County, Illinois, in Cultivator and Country Gentleman.]

June 16, 1870, v. 35, p. 372. Spring wheat is attacked by chinch bugs. July 14, 1870, p. 436. Winter wheat and rye are too mature to be much injured, but spring wheat, oats, and corn are being destroyed. July 21, 1870, p. 452. Chinch bug in corn miles away from stubble fields of winter or spring grains. Attack foot of corn stalk, or tassel.

RILEY, C. V.—The Chinch Bug—*Micropus leucopterus*, Say. (Second Ann. Rept. State Ent. Mo., pp. 15-37, fig. 1. Reprinted in part in Western Rural, July 24, 1875.)

Substantially the same as conjoint article by Walsh and Riley, in Am. Ent., v. 1, p. 169 (noted above), excepting matter in the former concerning Shimer's theory of epidemic disease.

PRAIRIE FARMER, Sept. 17, 1870, v. 41, p. 292. Sowing Winter Wheat on Ground infested by Chinch Bugs.

Replying to "G. W. P." of Delavan, Tazewell Co., who reports the country alive with chinch bugs and asks advice as to sowing

late or early, or not at all, editors state that they have never heard of serious injury to young wheat in fall, but suggest that it might be well to sow late, giving current reasons for their opinion. As to injury the next season, they say: "The destructive hosts of young chinch bugs do not make their appearance till near the middle of June, and at this time the winter wheat is usually too far advanced to be much injured by them. Spring wheat and barley are the crops in which chinch bugs have committed such havoc."

SHIMER, HENRY.—Entomological Notes. (Trans. Ill. State Hort. Soc., 1869, v. 3; n. s., pp. 275-281.)

Refers to chinch-bug epidemic of 1865, and to confirmation of his predictions of subsequent immunity from them. Says there is much more to learn about the chinch bug, some obscurity yet lingering around its natural history. Speaks of larva of *Hippodamia maculata* and *Chrysopa plorabunda* feeding on chinch bugs, and states that he reared the former, under confinement, to the perfect state, feeding them with chinch bugs only. Details of observations and experiments showing that the *Chrysopa* feeds voraciously upon the chinch bug. Speaks at some length of the inherent probability of epidemic diseases among the lower forms of life, and says that the causes of disease among insects are laudable and proper objects for the study of the practical entomologist.

1871.

GLOVER, TOWNEND.—Report of the Entomologist. (Rept. [U. S.] Commiss. Agric., 1870, p. 89, fig. 59.)

Gives short general account of the chinch bug. Eggs deposited in ground—about five hundred by one female. The insects, both larva and pupa as well as the imago, "puncture and apparently poison the terminal shoots, buds, and the most succulent parts, of growing plants of grain, grass, maize, potatoes, and other vegetables, but do not attack woody plants." Two broods annually; perhaps three in the South. Most destructive in hot dry summers; heavy rains said to destroy them. Early grain most likely to escape their ravages. As remedies, recommends rolling, burning dead vegetation and rubbish along fences, burning dry straw on spots where they congregate, and sowing gas lime broadcast over infested fields (six or seven bushels to the acre) or dropping a handful of it on each hill of corn when infested. He says: "According to Dr. Shimer, coal-tar is of no use as a remedy. Quails are said to feed greedily upon the insects, and should therefore be protected."

[LEBARON, WM.]—Topics of Interest for the Coming Season: Chinch Bugs, Potato Beetles, and Codling Moths. (Prairie Farmer, May 6, 1871.)

Makes general mention of the chinch-bug situation in Illinois, stating that the insect hibernated in moderate numbers, and as grain was sown early he does not apprehend disastrous visitation unless June should be hot and dry. Awaits developments.

J[OHNSON], B. F.—[Letters from Champaign County, Illinois, in Cultivator and Country Gentleman.]

June 1, 1871, v. 36, p. 340. "The chinch bug, which is not seen on the calcareous soils south of latitude 39°, has done a great deal of damage north of that parallel; but the bugs are now believed to be migrating, and though they do not go in clouds and darken the air like locusts in Algeria and grasshoppers in Utah, they are flying in countless numbers in a southwesterly direction." June 8, 1871, p. 364. "The chinch bugs are taking the oats." Sept. 7, 1871, p. 564. Mentions presence of drouth and chinch bugs in large portions of Illinois, Iowa, Wisconsin, and Minnesota, which are causing immense loss. In attacking corn, bugs begin at "brace roots" and go up, sucking sap as they go. Drouth and chinch bugs "hunt in couples." Sept. 21, 1871, p. 597. Chinch bugs are still [Sept. 14] at work in Champaign county.

CULTIVATOR AND COUNTRY GENTLEMAN, June 8, 1871, v. 36, p. 361.
An Insect Year.

Scores of complaints of chinch bugs come from Illinois and Iowa, and some from other sections."

PRAIRIE FARMER, July 7, 1871.

From Livingston Co, June 28, 1871, a correspondent reports total ruin to spring wheat by chinch bug, and great damage to corn and oats. Probably not one tenth of the oats in the county will be harvested, while much of the corn has been killed by the bugs, and scarcely a piece can be found which is not more or less injured.

[LEBARON, WM.] —Visit to McLean and Tazewell Counties. The Chinch Bugs. (Prairie Farmer, Aug. 5, 1871.)

Records his personal observation of the "desolated fields" and "blasted harvest" of the above-named counties, where, he says, "they raise chinch bugs instead of spring wheat." Speaks of an irregular periodicity in the appearance and disappearance of the insect, and of the ominous warnings they give of their advent one or two years before their onslaught, if one carefully notes their history. Says that unmistakable warning was given in 1870 of the prevalence of the bugs this season [1871]. They were also noticed during the winter by their odor, as the shocks of corn were fed, and were flying abundantly early in spring. These were harbingers of the hosts "which have devastated the fields of spring wheat and barley all through the central counties of Illinois, and also in parts of Iowa, Missouri, Kansas, and the southern border of Nebraska." Believes that by abandoning the raising of spring wheat and barley (if driven to the necessity) we can get rid of the chinch bug, —although he notes rare instances where the insect seems to have bred in oats.

[LEBARON, WM.]—The Chinch Bug. (Prairie Farmer, Aug. 12, 1871.)

Never before spread over so large an area. No heavy cold rain in June, which, so far as known, is the only destructive agency that operates against the chinch bug to any great extent. Knows of no predaceous or parasitic enemies. A correspondent calls attention to absence of chinch bugs from corn about which ants have thrown their hillocks of sand. Prospect for small grain in 1872 is discouraging. If the damage were confined to small areas, LeBaron would advise abandonment of spring wheat and barley; but says the matter assumes a more serious aspect, when we consider that more than half of Illinois and considerable portions of Missouri, Kansas, Iowa, and Nebraska are affected. The alternative of giving up wheat altogether and planting only corn would answer for a small area, but not for a large one, because of the effect on supply and demand. Every one must use his own judgment; but we can see no other rational course than to abandon spring wheat and barley wherever chinch bugs have prevailed the present season, and run the chances upon winter wheat, rye, and other staple crops. When myriads of bugs have settled on a wheat field nothing can be done. Plowed furrows and boards set edgewise and smeared with coal-tar have been used to obstruct passage from one field to another.

[LEBARON, WM.]—The Chinch Bug and Other Insects. (Prairie Farmer, Aug. 26, 1871.)

First quotes a letter from a correspondent who deprecates the recent practice of plowing under corn stalks as one which saves the lives of the chinch bugs, urging, instead, the burning of the stalks. LeBaron says the suggestion is in the right direction, but mentions some practical difficulties in carrying it out, and also notes its insufficiency as a remedy.

[LEBARON, WM.]—The Chinch Bug Once More. (Prairie Farmer, Sept. 2, 1871.)

Writes in reply to the following questions submitted by a Nebraska farmer: "(1) Have we greater reason to fear the recurrence of the chinch bug next season on account of their great prevalence at the present time? (2) Will these pests be likely to remain with us late enough to do fall wheat damage? (3) All things considered, which would involve the least risk, to put in largely spring wheat or winter wheat?"

After a consideration of some general principles as to insect multiplication and natural checks thereupon, he says in reply to No. 1, "Yes, unless there are some agencies at work of which we are totally ignorant." Speaks of June rains as an important check upon prevalence of chinch bug, and believes that it "has never been known to prevail in any year when the month of June of the preceding year has been attended by heavy rains." No. 2 he answers in the negative, and No. 3 in favor of winter wheat, as it is not especially liable to injury either in fall or spring.

CULTIVATOR AND COUNTRY GENTLEMAN, Oct. 26, 1871, v. 36, p. 680.

Note that a "Missouri Republican" correspondent had successfully [?] used salt to prevent progress of bugs in corn field. Sprinkled row of corn just ahead of bugs, and earth between it and the infested corn with strong brine.

PRAIRIE FARMER, Nov. 11, 1871. Straw Injured by Chinch Bugs.

In reply to a query on the subject, a correspondent says that he feeds straw and corn damaged by chinch bugs to stock without injury. In regard to getting rid of the insect by raising no spring wheat he says, "In this region [Kinmundy, Marion Co.] we raise no spring wheat nor barley, but oats, winter wheat, and plenty of chinch bugs, and they breed in the wheat first."

[LEBARON, WM.]—Introduction. (Prairie Farmer, ———, 1871.)

Chinch bugs were sufficiently numerous in localities, to start destructive colonies in June. The most important preventive measure against them is to sow spring wheat as early as possible. It is not the hibernating bugs but their summer progeny that do the mischief. These do not appear until about the middle of June, and if we can get spring wheat well matured by that time it will escape their ravages. For this reason the earlier winter wheat is not often injured by them.

[LEBARON, WM.]—The Chinch Bug once more. (Prairie Farmer, ———, 1871.)

In reply to questions, says that the absence of cold drenching rains, and the slight check by birds and parasitic insects, indicate excessive prevalence of chinch bug in 1872; but as it feeds but little in the fall, winter wheat, maturing early in the spring, will escape serious damage; and the chances for winter wheat are very much better than for spring wheat where chinch bugs have prevailed this season.

1872.

BETHUNE, C. J. S.—Insects affecting the Wheat Crops. 3. The Chinch Bug (*Micropus leucopterus*, Say). (Rept. Ent. Soc. Ontario, 1871, pp. 55-57.)

A compiled account of the history, natural history, injuries, and enemies of the insect, with notice of remedies.

GLOVER, TOWNEND.—Report of the Entomologist. (Rept. [U. S.] Commiss. Agric., 1871, p. 84, fig. 17.)

States that the chinch bug has been very destructive in Iowa, Kansas, and the Northwestern States. Quotes a correspondent who finds salt a successful barrier to progress of chinch bug. Stirrs half a gallon of salt into a pail of water and sprinkles ground and row of corn just ahead of the bugs. He says they go from row to row "with almost as much precision as a man plowing the corn."

GLOVER, TOWNEND.—Report of the Entomologist. (Rept. [U. S.] Commiss. Agric., 1872, p. 121.)

Mentions regions where special damage was done to sorghum by the chinch bug. Newly-sown [fall:] wheat injured in several counties in Indiana and Missouri, and in Linn Co., Kansas. Franklin Co., Ill., was overrun to the great damage of the corn crop, as also certain counties in Indiana and Missouri, and Linn Co., Kansas. In Crawford Co., Missouri, three distinct broods are noted: first early in May; second late in June; third about the last of August. [First and third are, of course, the same.]

LEBARON, WM.—The Chinch Bug (*Micropterus leucopterus*, Say). (Third Rept. State Ent. Ill., 1871, pp. 142-156. See also 5th Ann. Rept. Board of Trustees Ill. Industrial Univ., 1871-72, pp. 193-200.)

Notes the excessive prevalence of the chinch bug in 1871. The most serious depredations occurred in a belt of territory 100 miles wide, commencing in the western part of Indiana and extending more than 400 miles west, and embracing more than 40,000 square miles. Over this area spring wheat was reduced to not more than a quarter of an average crop, and in many places wholly destroyed; barley was less than half a crop; and oats not more than three fourths. Center of belt a little north of the center of Illinois, being about on a line with the junction of Iowa and Missouri, and taking in a corresponding part of Southern Iowa and Nebraska and of Northern Missouri and Kansas. South of this belt no considerable damage, owing to prevalence of winter wheat as a crop [?]; and north of it a tolerable crop of spring wheat was harvested, though chinch bugs were numerous enough in Northern Illinois and Southern Wisconsin to damage the crop somewhat and to excite serious apprehensions for the future. Estimates the "total loss by chinch bugs in the State of Illinois in the year 1871 upwards of \$10,500,000," and the combined loss in the Northwestern States, from this insect, during the same year, upwards of \$30,000,000. Treats of destruction and prevention under six heads. (1) Natural enemies. Lady-bugs, larvæ of lace-winged flies, and quails are, he says, so reported. He has no hope of essential aid from natural enemies in destruction of chinch bug. (2) Early sowing. Says this seems not a reliable measure. In this connection recommends the plan of sowing stimulating substances (as salt and lime) with the grain to hasten ripening as a plan well worthy of trial, and cites an encouraging instance. (3) Prevention of migration. Mentions as the two principal measures, plowing a succession of furrows across path of insects, and barricading with fence-boards besmeared with coal-tar or kerosene oil. Says the last plan is most effective, but that the boards may be discarded as an unnecessary trouble and expense, as it has been demonstrated that a stream of coal-tar poured on the ground will intercept the progress of the insects if renewed every other day. (4) Burning corn stalks and rubbish in the fall. On this point he quotes at some length from a letter written him on the subject by a practical

observer who comes to the following conclusion: "As to burning stalks with a view to destroying the chinch bugs I have but little faith in it. Could the stalks be burned before excessive cold weather sets in, very probably a large portion of the bugs could be destroyed; but by the time the corn can be harvested, and the stalks are dry enough to burn, the chinch bugs have taken to their legs or wings and left for parts unknown." (5) Abstaining from the cultivation of those grains upon which they chiefly subsist. He thinks that bugs will probably not breed in oats to any extent after the first year of their infesting it [since disproven], and that abandonment of the cultivation of spring wheat and barley, if there is concert of action over a considerable territory, will rid that section of the chinch bug. The presence of chinch bugs will not prevent the raising of corn or winter grains the coming year. Speaking of other proposed remedies he approves of burning badly infested grain just as bugs are about to migrate; says that the practice of sowing winter rye with spring wheat is founded on the mistaken notion that chinch bugs feed on the blades of grain; and regards all attempts to check their depredations by throwing offensive substances upon them as labor lost. Speaking of natural agencies which are destructive to these insects, he inclines to the view that they may be destroyed by the severity of winter as well as by the rains of summer.

J[OHNSON], B. F.—[Letters from Champaign County, Illinois, in *Cultivator and Country Gentleman*.]

Apr. 25, 1872, v. 37, p. 261. "The chinch bugs have stood the winter, and are about by millions." May 23, 1872, p. 325. "On May 5, chinch bugs were out by millions. Nothing will save the oats, spring grain, and corn crop, except a continuance of such cool and moist weather as we have had for a week." Aug. 8, 1872, p. 501. "The chinch-bug damages this season are scarcely to be estimated, so limited are they."

[LEBARON, WM.] —Chinch-Bug Experiences of 1872. (*Prairie Farmer*, Aug. 24, 1872.)

Article deals chiefly with the questions of the places of hibernation and climatic influences. Thinks fallen leaves constitute their "ordinary" or "normal" places of hibernation, and where no trees furnish these, "there is," he says, "good reason to suppose that many of them fly to the nearest woodland in order to obtain their natural protection." As exceptional, mentions their being found under bark of logs and in worm-eaten nuts. Says that the chinch bug certainly hibernates in the woods to a sufficient extent to perpetuate the race, but whether in numbers to threaten crops the succeeding year has not been determined. Considering the excessive prevalence of the chinch bug in 1871, and its "almost total disappearance" the next year in the belt of territory where its ravages were so serious, he does not think the fact can be explained by the severe cold with which the winter opened, and the scarcity of snow, but is rather due to the timely rains in May

and June; and he says experience teaches that after a chinch-bug season we cannot, the next year, argue immunity from damage by these insects from any peculiarities of the winter.

LEBARON, WM.—Lecture on Insects. (Fourth Ann. Rept. Board of Trustees Ill. Industrial University, 1870-71, pp. 176-180.)

The chinch bug furnishes the most remarkable example on record of the efficacy of climatic influence in exterminating noxious insects. The chinch bug delights in dry, hot weather. The rainy season of 1869, embracing the month of June, which is the chief feeding and propagating season of these insects, almost exterminated them from Illinois; but they are again becoming numerous, and in some localities there is reason for the gravest apprehension for the spring wheat crop of the coming year. In those districts where they were numerous last fall, sow sparingly of spring wheat next year, and get the seed into the ground as early as possible. Burn corn stalks and other litter that lie about fields and fences. It is not probable that these insects would ever multiply to any great extent if spring wheat were not cultivated. They attack barley, but will not eat oats unless compelled to [?]. Winter rye, like winter wheat, is too far advanced in early spring, in this part of the country, to be much injured by them. Corn does not easily succumb to them, generally only a few rows being injured; sometimes, however, whole fields are laid waste. These insects generally migrate on foot. Furrows plowed across their path, or boards set on edge and smeared with coal-tar have been used to arrest their progress. The efficacy of all such methods will depend on the thoroughness and ingenuity with which they are carried out.

1873.

PACKARD, A. S., JR.—Insect Calendar. The Insects of June. (Our Common Insects, p. 203.)

Quotes a few lines from Harris concerning the time of season the chinch bug appears, and its food plants; and, as an indication of its wide distribution, says he has detected it in August on the summit of Mt. Washington.

PRAIRIE FARMER. RECORD OF THE SEASON.

Apr. 5, 1873, v. 44, p. 112. *Hancock Co.* (Mar. 26.) "Winter wheat is badly used up on black prairie soil. Some are re-sowing with spring wheat, but most of our farmers refuse to have it on their farms, fearing another plague of chinch bugs." *Livingston Co.* (Mar. 26). "Small grain has been wholly discarded here for the last two years on account of the chinch bug." June 21, 1873, p. 200. *Union Co.* (June 7). "Chinch bugs are numerous in a good deal of our wheat this spring." June 28, 1873, p. 208. *Fulton Co.* (June 7). The chinch bug is out in full force, but the present prospect for spring wheat and oats is good. July 19, 1873, p. 232. *Clay Co.* (5). Chinch bugs plenty. *Cumberland Co.* (10). "Corn will make a fair crop, if the bugs will let it alone." *Fayette*

Co. (8). Chinch bugs numerous. Have killed a great deal of corn already. Aug. 2, 1873, p. 248. *Kane Co.* Chinch bugs numerous, and doing great damage to late-sown wheat. *McHenry Co.* (July 21). Many pieces of spring wheat are being injured. *Union Co.* Corn is being seriously injured. Aug. 9, 1873, p. 256. *Clay Co.* (1). Many chinch bugs. Oct. 4, 1873, p. 320. *Shelby Co.* (Sept. 18). "Between the drouth, frost, and chinch bugs, our corn crop will be a small one." Nov. 8, 1873, p. 360. *Clay Co.* (Oct. 20). "The country is full of chinch bugs. Early wheat injured by bugs and grasshoppers." *Gallatin Co.* (Oct. 25). "Wheat that was put in with a drill, although damaged by the bug, was very nearly a full crop, while that sown broadcast was not, for two or three counties, one third of a crop." Corn also considerably damaged by chinch bug.

IOWA. July 5, 1873, p. 216. *Scott Co.* (June 17). A few chinch bugs, but they are not general, and spring wheat is growing luxuriantly.

KANSAS. May 3, 1873, p. 144. *Crawford Co.* (Apr. 19). "A few persevering farmers have sown spring wheat, as usual, but as this crop is invariably destroyed by the chinch bugs they are compelled to import seed every year." July 5, 1873, p. 216. *Labette Co.* (June 23). "Last Thursday and Friday were days of destruction in Labette and Cherokee counties. The wheat acreage was one third more than last year, but last Thursday and Friday more than that one third was destroyed by chinch bugs. Rank and early wheat are late—in many cases will not pay for harvesting. * * * All corn fields adjoining wheat fields are covered with chinch bugs." July 12, 1873, p. 224. *Neosha Co.* (June 25). "Wheat is about half a crop; oats look fine, and corn is good. Chinch bugs very bad." July 26, 1873, p. 240. *Butler Co.* (14.) "Spring wheat all considerably injured." Nov. 1, 1873, p. 352. *Labette Co.* (Oct. 20). "An average crop of wheat, though much injured by the chinch bug."

MISSOURI. July 26, 1873, p. 240. *Shelby Co.* Wheat was injured considerably. Aug. 2, 1873, p. 248. *Scotland Co.* Some spring wheat nearly destroyed. Dec. 6, 1873, p. 392. *St. Charles Co.* (Nov. 20). "Corn, as a general thing, is a poor yield. Cause, drought and chinch bugs."

J[OHNSON], B. F.—[Letters from Champaign County, Illinois, in *Cultivator and Country Gentleman*.]

July 24, 1873, p. 468. "The chinch bug [July 16] is unheard of." Aug. 14, 1873, p. 516. Remarking on freedom of corn from insect enemies, states that chinch bugs do not enter corn fields till after small grain and meadows are exhausted.

[LEBARON, WM.]—Nebraska Grasshopper.—Twig Pruners.—Chinch Bugs. (*Prairie Farmer*, Aug. 16, 1873, v. 44, p. 257.)

To a correspondent from Cobden, who writes, "What can be done to stay the ravages of the chinch bugs? They are new-

comers here, and we do not know what to do," he replies that if he is correct in his impression, winter wheat, as a rule, escapes the ravages of the chinch bug; and that since as far south as Cobden winter wheat is the variety almost exclusively raised, his correspondent need have no serious apprehensions in regard to this pest. He also expresses the opinion that, although not yet arrived at the point of adopting so desperate an expedient, the farmer may virtually exterminate the chinch bug by ceasing to raise wheat.

PRAIRIE FARMER, Oct. 11, 1873, v. 44, p. 321. The Wheat Crop.
[From the September Report of the Department of Agriculture.]

"In INDIANA this crop [wheat] has suffered from winter-killing, the fly, chinch bugs, and heavy rains in the shock." In ILLINOIS, "Spring wheat has been injured to some extent by chinch bugs, rust, and storms." In MISSOURI and KANSAS chinch bugs are said to have reduced the yield of wheat in some counties.

[LEBARON, WM.]—Chinch Bugs. (Prairie Farmer, Oct. 18, 1873, v. 44, p. 331.)

Answer to letter from "Egypt," who writes from Odin Sept. 22, 1873. Letter given in full.

"Egypt" states that he has suffered from the ravages of chinch bugs for twenty-eight years, during which time they have steadily increased in numbers. While at first they only injured oats and spring wheat, they now swarm in corn fields; and this summer have attacked meadows and pastures. Formerly they crawled from field to field; now they fly in swarms. Hungarian and buckwheat are no longer any protection, for they fly long distances. Years ago it was thought that the abandonment of spring wheat would exterminate them; now, to starve them out, we would have to make the land a desert.

LeBaron replies in a general rather than a specific manner, and asks for more definite information concerning the charges brought against the chinch bug as a southern insect, saying that from a northern point of view it has been regarded as a destroyer of the spring grains, especially wheat and barley. He dwells at some length upon the natural history of the insect, telling "Egypt" that the "crawling stage" is by far the most destructive period of the insect's life; that they hibernate mostly, if not exclusively, in the winged state, flying only when about to deposit their eggs, the parent bug perishing soon after. Probably never originate in corn, and do not thrive and propagate on oats alone. In the Northern States, lay their eggs on the roots of wheat and barley. He says, "We should expect that in this more genial clime [Southern Illinois] the chinch bug might become a more permanent resident, but on some accounts less destructive, than at the North, * * * where it has been both the most destructive, and the most changeable and evanescent of insects."

1874.

PRAIRIE FARMER. RECORD OF THE SEASON.

Mar. 7, 1874, v. 45, p. 80. *Union Co.* (Feb. 19). "Chinch bugs very plenty about here in sage-grass patches and under the bark of trees." Mar. 14, 1874, p. 88. *Edwards Co.* (Feb. 20). For the last three years the hay crop has been light, the army worm, drought, and chinch bug being the cause. Mar. 28, 1874, p. 104. *Franklin Co.* (Mar. 16). "Our crops last year were not an average, on account of chinch bugs and drought." Apr. 11, 1874, p. 120. *Kane Co.* (Mar. 20). "But a small amount of wheat will be sown; barley will be no better; it was nearly a failure last year; it propagates the chinch bug." Apr. 25, 1874, p. 136. *St. Clair Co.* (Apr. 16). The chinch bug is just appearing. Our wheat is hardly ever hurt by it, as, by the time the young ones are ready for it, the straw is too hard for them. *Union Co.* (Apr. 13). "Wheat looks as fine as we could wish, * * * but our farmers seem greatly alarmed about the chinch bug. I tell them they need not fear him if it keeps on raining every few days." June 13, 1874, p. 192. *Kane Co.* (5). "Wheat, oats, and barley bid fair for a large crop, if the chinch bugs do not destroy them. They have already made their appearance in some fields." *Menard Co.* "The chinch bug has come and will probably take the wheat and oats and some fine fields of corn." June 20, 1874, p. 200. *Brown Co.* (11). Wheat is injured by the chinch bug. *Will Co.* (8). Chinch bugs quite numerous, but the rains will stop their progress. July 4, 1874, p. 216. *Moultrie Co.* (June 20). Oats and wheat injured by chinch bugs. July 11, 1874, p. 224. *Christian Co.* (June 29). Wheat and corn injured. *Menard Co.* (June 29). Spring wheat ruined, and unless it rains soon oats and corn will be devoured. *Moultrie Co.* (June 25). Spring wheat killed and the chinch bugs are on the corn. July 18, 1874, p. 232. *Clark Co.* (June 27). Wheat injured. *Clinton Co.* (July 6). In sections of this county, and Marion, Washington, and Jefferson counties, severe drought and chinch bugs. One quarter of the corn destroyed or badly injured by the bugs. *Coles Co.* (July 4). Have done considerable damage wherever there was any small winter grain. Wheat and rye almost an entire failure, and some corn adjoining entirely ruined. *Hancock Co.* (July 8). Chinch bugs very numerous. *Iroquois Co.* (July 6). Spring wheat and oats infested. *Kane Co.* (July 10). Chinch bugs more destructive than for years past. *Menard Co.* Corn infested. *Montgomery Co.* (July 9). Chinch bugs sweeping off acres of corn. *Shelby Co.* (July 6). Wheat and oats very much injured, and corn now being seriously damaged. July 25, 1874, p. 240. *Boone Co.* (13). Spring wheat badly injured. *Clay Co.* (12). Corn damaged. *Johnson Co.* (14). Wheat and corn infested. *Macon Co.* (12). Corn, wheat, and oats very badly damaged. *Marion Co.* (June 26). Chinch bugs very destructive. *Scott Co.* (July 14). Plenty of chinch bugs. Aug. 1, 1874, p. 248. *Franklin Co.* (July 21). Oats badly damaged and some

corn killed. Bugs still at work. *Kane Co.* "Dry weather and chinch bugs are using up the corn." *Macoupin* and *Sangamon Co.'s.* (July 23). Spring wheat a complete failure and injury to corn very great. *Wabash Co.* (July 15). Wheat and oats were killed by the chinch bugs in some instances, and late corn is likely to suffer terribly. Aug. 8, 1874, p. 256. *Rayette Co.* (July 26). Chinch bugs very numerous. *La Salle Co.* (27). "More bugs than wheat." *Logan Co.* (28). Spring wheat almost a failure. *Montgomery Co.* (20). Killing a great deal of corn. *Stark Co.* (28). Did little damage. *Union Co.* (27). Very destructive. Aug. 15, 1874, p. 265. *Franklin Co.* (July 25). "Chinch bugs plenty." *Hancock Co.* (Aug. 4). "Some chinch bugs." *Johnson Co.* (July 24). Have just had fine rains. Chinch bugs have left for parts unknown. *Lulu, — Co.* (Aug. 5). Some spring wheat not cut on account of chinch bugs, and considerable corn is destroyed. Next brood of bugs hatching by the million. Aug. 22, 1874, p. 272. *Kane Co.* (7). Corn is being badly damaged. Aug. 29, 1874, p. 280. *Logan Co.* (15). Some spring wheat wholly destroyed. *McHenry Co.* (20). The chinch bug has had much to do with destroying the crops. *Scott Co.* Corn damaged by chinch bug and drought. Sept. 5, 1874, p. 288. *Carroll Co.* (Aug. 24). "A good smell of chinch bugs this season; doubtless getting ready for next year." *Hancock Co.* (Aug. 24). Chinch bugs in the corn. Late corn will suffer severely unless it rains very soon. *Sangamon Co.* The chinch bugs destroyed our spring crops of wheat and barley, most of our oats, and scores of acres of corn. *Williamson Co.* (Aug. 24). Wheat never better. Ripened before the bugs injured it. Sept. 12, 1874, p. 296. *Fulton Co.* (Aug. 28). Drouth and chinch bugs have cut the corn short one half. *Sangamon Co.* (Sept. 1). Millions of chinch bugs, but a good crop of wheat notwithstanding. Sept. 26, 1874, p. 312. *Effingham Co.* (5). Wheat and corn about half a crop in our neighborhood; oats a total failure. Chinch bugs worse than ever before. *Hancock Co.* (18). More chinch bugs than ever before. Farmers cutting a good deal of the corn for feed. *Macon Co.* Spring wheat much injured by chinch bugs. Eggs laid by them hatched in time for some late corn to receive injury; but the bugs are now living on the fall wheat. *Tazewell Co.* Spring wheat injured. Oct. 3, 1874, p. 320. *Lulu, — Co.* (Sept. 11). Corn not half a crop. Chinch bugs now going to early-sown wheat. *Christian Co.* (Sept. 21). Much wheat (all the spring wheat), oats, and corn destroyed. Small grain does not pay here. *Montgomery Co.* (Sept. 21). Chinch bugs have, in places, taken volunteer wheat and oats. Farmers afraid to sow wheat. *White Co.* (Sept. 21). In western part of county corn badly damaged. *Will Co.* (Sept. 21). The little wheat raised, badly hurt by chinch bugs; rye somewhat damaged. Oct. 17, 1874, p. 336. *McDonough Co.* (7). "Spring wheat light and hurt by the bugs." Oct. 24, 1874, p. 344. *Iroquois Co.* (12). Drought and chinch bugs caused short crops. Spring wheat plowed under just as it was heading out, while chinch bugs were young and numerous. Oats,

when heading, promised forty bushels; chinch bugs reduced it to twenty. Corn also injured by them. Oct. 31, 1874, p. 352. *Sangamon Co.* (21). Second brood of chinch bugs did much damage to corn. Nov. 14, 1874, p. 368. *Piatt Co.* "Chinch bugs and grub worms more than plenty." Nov. 21, 1874, p. 376. *Fayette and Macoupin Co's.* (9). Corn severely injured. Nov. 28, 1874, p. 384. *Cook Co.* Hundreds of acres of wheat and thousands of acres of corn destroyed. *Macon Co.* (17). Low, flat fields of corn seem to withstand ravages of chinch bug the best. Oats and wheat crops fair where chinch bugs did not take them, but some pieces of wheat were entirely devoured. Dec. 12, 1874, p. 400. *Boone Co.* Chinch bugs abundant. "Many fields of grain were cut only for feed and litter." *Iroquois Co.* (Nov. 30). Corn and wheat injured by chinch bugs.

IOWA.—Aug. 29, 1874, p. 280. *Jefferson Co.* Drought and chinch bug. Wheat light; oats good; corn a good deal injured.

KANSAS.—May 23, 1874, p. 168. *Labette Co.* (May 11). "Chinch bugs, which destroyed a great deal of wheat last year, are very abundant this spring." July 11, 1874, p. 224. *Jefferson Co.* Chinch bugs in myriads. Much wheat destroyed, that which is cut being about half a crop. Oats and corn now infested. *Sumner Co.* Spring wheat not worth cutting. July 18, 1874, p. 232. *Labette Co.* (June 25). Wheat scarcely hurt at all by chinch bugs. Aug. 1, 1874, p. 248. *Marion and Sumner Co's.* (July 20). Spring wheat and corn injured in the former county; spring wheat a little damaged in the latter. Aug. 8, 1874, p. 256. *Wilson Co.* Chinch bugs numerous. Aug. 29, 1874, p. 280. *Douglas Co.* (Aug. 17). Corn greatly reduced by chinch bugs, drouth, and grasshoppers. Wheat nearly an average crop. Sept. 12, 1874, p. 296. *Crawford Co.* (Aug. 28). Half the wheat taken, and corn will scarcely average five bushels to the acre. Nov. 7, 1874, p. 350. *Marshall Co.* "Dry weather, chinch bugs, and grasshoppers used up all the corn and vegetables." Dec. 19, 1874, p. 408. *Franklin Co.* (4). Corn crop almost a failure on account of the grasshoppers, chinch bugs, and drouth.

MISSOURI.—July 18, 1874, p. 232. *Dade Co.* (July 8). Wheat considerably damaged, but corn has suffered severely. Some fields have ten to twenty acres entirely cleared. Aug. 15, 1874, p. 265. *Linn Co.* (July 31). Corn damaged by bugs and drouth. Aug. 22, 1874, p. 272. *St. Charles Co.* (10). Corn, wheat, and oats good, although injured by chinch bugs. Sept. 12, 1874, p. 296. *Cass Co.* (Sept. 2). Corn cut short one half by chinch bug and dry weather. Oct. 10, 1874, p. 328. *Bates Co.* (Sept. 21). Wheat, oats, and corn crops nearly failures on account of dry weather, chinch bugs, and grasshoppers. *Carroll County.* (Sept. 25). "Chinch bugs more plenty than corn." Nov. 7, 1874, p. 360. *Saline Co.* (Oct. 22). "Chinch bugs and insects of all kinds seemed to vie with the hot dry weather in the destruction of crops."

WISCONSIN.—Aug. 1, 1874, p. 248. *Dane Co.* (July 20). Destroying wheat and barley. Worse than for many years before. *Green Co.* (July 20). Going from wheat to corn by millions. Sept. 19, 1874, p. 304. *Doane Co.* (8). Greater part of the corn badly damaged.

J[OHNSON], B. F.—[Letters from Champaign County, Illinois, in *Cultivator and Country Gentleman.*]

June 11, 1874, v. 39, p. 372. Much talk of the chinch bug, as might have been anticipated from the dry weather in May. Aug. 13, 1874, p. 517. Chinch bugs on every farm in Central Illinois. Formerly they were confined to spring wheat and oats, penetrating only a few rods into corn fields on the exposed sides. This year they are everywhere. Aug. 20, 1874, p. 532. Incidental mention of chinch-bug damage to corn. Sept. 3, 1874, p. 565. In answer to an inquiry for the reason that farmers cut grain when attacked by chinch bugs, states that it is to secure it for feed. Oct. 15, 1874, p. 659. Cattle and horses injured by eating corn stalks infested by chinch bugs, some deaths being reported. Symptoms resemble Texas fever.* Suggests sowing insect-killing plants, like tobacco, hemp, nightshade, etc., as barriers. Origin of "chintz" and "chinch." Oct. 29, 1874, p. 692. Chinch bugs are flying in swarms at midday (Oct. 21). Thinks they are migrating. Drift before a light wind, but would probably be driven to earth by a heavy one.

FOOT, LAWRENCE.—A Way to stop Chinch Bugs. (*Prairie Farmer*, July 11, 1874, v. 45, p. 217.)

If the bugs are on a few outer rows of corn, plow a ditch between them and the remainder of the corn, keeping it dusty by dragging a log along it. Very few bugs can cross this ditch.

P., S. M.—The Prospect in Central Illinois. (*Prairie Farmer*, Aug. 1, 1874, v. 45, p. 241.)

"The damage already done to the growing corn in many localities by the chinch bug is beyond repair."

PRAIRIE FARMER, Aug. 8, 1874, v. 45, p. 249. Condition of the Crops. (Extract from Crop Report.)

In the Northwestern States spring wheat suffered especially from the ravages of chinch bugs and other insects. Damage of more or less serious character to this crop by chinch bugs in sections of Indiana, Illinois, Wisconsin, Iowa, Missouri, and Kansas.

PRAIRIE FARMER, Aug. 15, 1874, v. 45, p. 257.

An Iowa correspondent objects to furrow and log-dragging as less effectual against the chinch bug than sowing a peck of winter wheat per acre, with spring wheat.

* Recent inquiry has not verified this report. S. A. F.

CLARK, J. A.—Destroying Chinch Bugs. (Cultivator and Country Gentleman, Aug. 20, 1874, v. 39, p. 531.)

Writing from Jefferson Co., Wis., reports the gathering of the bugs under oat bundles in field, and suggests destroying them there. [Mistakes cast pupal skins for dead bugs.]

JACKSON, WM.—What of the Crops. (Prairie Farmer, Sept. 19, 1874, v. 45, p. 297.)

Here [Godfrey, Madison Co.?] we had no rain, he says, from June 25 to Aug. 21, except enough to lay the dust once or twice. Oats, from drought and chinch bugs, only about half a crop, and corn still less.

HARRISON, RANDOLPH, [AND EDITORS].—The Chinch Bug. (Cultivator and Country Gentleman, Oct. 15, 1874, v. 39, p. 659.)

Harrison writes from Cumberland Co., Va., that chinch bugs have done serious damage. Especially fond of broom corn. Editors summarize observations of Harris, Packard, Shimer, and others, and advocate burning, sowing strips for bait, and trenches. Usually injurious only in hot, dry seasons.

CULTIVATOR AND COUNTRY GENTLEMAN, Oct. 15, 1874, v. 39, p. 668.
Record of the Times.

Montgomery Co. (5). Chinch bugs and dry weather chief causes of failure of corn.

1875.

J[OHNSON], B. F.—[Letters from Champaign County, Illinois, in Cultivator and Country Gentleman.]

Jan. 7, 1875, v. 40, p. 5. Replying to inquiry, "If there is danger that chinch bugs will be propagated by sowing oats from a crop injured by them," he says: "This insect lays its eggs in the earth about the foot of stalks of grain plants. It might be well to examine the seed carefully, and if chinch bugs are there sift them out if possible, then scald in hot water (but not sufficiently to kill the oat germ), and then roll in dry salt or some other pungent pickle before sowing." Apr. 8, 1875, p. 213. "It is so warm to-day [Mar. 30] that chinch bugs are collecting and coming to the surface in masses, under and about every piece of board, bunch of straw, and pile of corn stalks, and they are swarming through the whole of last year's weeds and rubbish that encumber grain, grass, and corn fields."

M., E. H.—The Chinch Bug Pest. (Prairie Farmer, May 22, 1875.)

Mentions enormous loss by chinch bugs in Kansas, and enumerates other states subject to the pest. Notes a petition to the last Congress from the Cherokee territory praying for loan of money because of damage from chinch bugs. Mention of habits and description of "scoop shears" which gather bugs as the outer rows of corn are cut,—which rows should be close planted.

GLOVER, TOWNEND.—Entomological Record. Insect Injuries. (Monthly Report U. S. Dept. Agric., May and June, 1875.)

A few chinch bugs in Virginia. They are reported in Arkansas, Kentucky, Indiana, Illinois, Wisconsin, Missouri, and Kansas.

THOMAS, CYRUS.—Chinch Bug. (Prairie Farmer, June 12, 1875.)

General article on the history and life history of the insect, with notice of remedies and literature. Pass the winter in the winged state; appear in spring between middle of March and first of May, and, at roots of wheat, deposit eggs, which hatch in about two weeks, the bugs reaching maturity in five or six weeks and depositing the second batch of eggs. The insects which hatch from these eggs usually attack corn, and, unless destroyed by climatic influences, live till cold weather and seek winter quarters in which to hibernate. Here they may be destroyed by burning the stalks or rubbish that afford them shelter. Limited areas which cannot be reached by fire may be thoroughly and repeatedly drenched with good effect. Farmers must act in concert. Refers to cases cited by LeBaron, Shimer, and Riley, indicating that cold may kill these insects, and mentions also an instance in which some were thawed from ice in which they had been frozen, and then moved about as in spring. Copious rains at the periods of egg-hatching great check upon multiplication. In a winter following a rainy season they will be reduced to a minimum. Two successive favorable years necessary to their fullest development, and they seldom appear in destructive numbers without having given warning the previous year.

CULTIVATOR AND COUNTRY GENTLEMAN, July 1, 1875, v. 40, p. 405.

A correspondent writes that the "growing of wheat has been almost abandoned in Will Co. because of the chinch bug."

CULTIVATOR AND COUNTRY GENTLEMAN, July 8, 1875, v. 40, p. 428.

Correspondent from Bond Co. says that rain has killed off nearly all the chinch bugs.

EVEREST, H. J.—Destroying Chinch Bugs. (Western Rural, July 17, 1875.)

Writes from Dane Co., Wis., of saving corn fields by use of fence boards and tar. Boards set up edgewise; dirt put against their lower edge, and tar poured along the top, it being renewed every five or six days. Holes dug in front of the boards, into which the bugs fell.

WESTERN RURAL, Oct. 23, 1875. Insect Injuries.

Extract from a summary by the U. S. Department of Agriculture of the injuries done by insects during the present year, which states that the chinch bug "made its power felt in only a few localities."

THOMAS, CYRUS.—Entomological Notes, No. 2. Winter Plowing and Spading.—Chinch Bugs. (Western Rural, Nov. 6, 1875.)

Exhorts farmers to report results of experiments for destruction of insects. Knowledge of what will *not* do any good is next in importance to a knowledge of that which will. Time now, he says, to apply torch to whatever rubbish may afford chinch bugs winter quarters. Knows no better practical preventive. Mentions finding a few bugs that had survived the wet weather of the summer, but had been destroyed by some insect enemy—probably the spotted lady bug (*Hippodamia maculata*).

THOMAS, CYRUS.—Lime for Chinch Bugs. (Prairie Farmer, Nov. 6, 1875.)

Thinks it probable that lime would be beneficial as a fertilizer, assisting the plant to resist the attack of the bugs, but gives it as his opinion that it will not destroy them unless administered in such quantities as to kill the wheat. Urges concert of action in burning them in their winter quarters.

GLOVER, TOWNEND.—Report of the Entomologist. (Report [U. S.] Commiss. of Agriculture for 1874, p. 127.)

In 1873 chinch bug heard of in only one county east of Alleghany Mountains—Halifax, Virginia. In 1874 more or less destructive to small grain, corn, and grass in various Atlantic Coast states and in West Virginia and Kentucky. It was also reported from various counties in Ohio and Indiana, and the drought favored their operations as far north as Wisconsin. They were quite injurious in some parts of Iowa, but their most fatal ravages were in Missouri, where they were so numerous on some farms as to swarm into houses and barns. They were particularly destructive to grass and grain, but in some localities corn adjacent to wheat suffered, and in others wheat on timber land measurably escaped. Kansas reports more or less injury in twenty-seven counties. In Illinois, destructive sweep still wider, embracing the following counties: Menard, Sangamon, Perry, Effingham, Fayette, Jackson, Clay, Madison, Clinton, St. Clair, Massac, White, Randolph, Cass, Pike, Logan, Cumberland, Hancock, Macon, Marion, Pope, Mason, McHenry, Crawford, Jersey, Macoupin, Montgomery, Moultrie, Morgan, Richland, Vermilion, Washington, Wayne, Piatt, Schuyler, Shelby, and Edwards. In some of these counties they appeared early enough to attack winter wheat before harvest and to make the wheat stubble a point of attack upon the various spring-sown crops.

MCHLEMAN, J. R.—Insect Life in Winter. (Trans. Ill. State Hort. Soc. 1874, p. 250.)

Mention of trapping chinch bugs and other insects under boards placed in orchard for that purpose.

RILEY, C. V.—The Chinch Bug—*Micropus leucopterus* (Say).
(Seventh Rept. State Ent. Mo., 1874, pp. 19-50. Appendix,
pp. 51-71, figs. 2, 3, 4.)

An exhaustive treatment of the subject, called out by the unparalleled damage done by the chinch bug in Missouri in 1874, and the general ignorance prevailing there concerning its history and habits. Ascertaining by circular of inquiry that his Second Report had a very limited circulation among the farmers of Missouri, the article in it on the chinch bug is reproduced in part. (For abstract of such quotations see a previous entry.)

The egg, larval stages, and pupa are described; Say's description of the imago quoted (supplemented by a short one by Dr. LeBaron); and Fitch's nine varieties are enumerated, to which another variety is added. The past history of the insect in Missouri (dating back to 1836) is given quite fully, much information having been called out by a circular of inquiry addressed to prominent farmers in every county of the State. Ravages of 1874 reported over wider range of country than previously, extending south to Texas and Arkansas and east to Virginia, some corn in Kentucky, even, being ruined. The total loss in Missouri, including only the staple crops of wheat, corn, and oats, amounted, at a low estimate, to \$19,000,000. Food plants, the cereals and grasses. Has seen young chinch bugs around roots of strawberry plants under circumstances indicating that they can feed on this plant. Eggs occasionally deposited on blades of the grain, but generally on roots of infested plants. Flights noticeable at three periods; in early spring, after wheat harvest, and just before seeking winter quarters. Migrate for food on foot. Where irrigation is impracticable, the following preventive measures must be the chief dependence: burning, rolling, invigorating the plant by manure, mixing seed or protecting one plant by another, preventing migration by use of coal-tar or furrow kept friable and dusty, winter work (burning rubbish and trapping) and combined action, and abstaining from cultivation of grains upon which the insect feeds. As possible remedial and preventive measures needing further trial, there is mention of the following expedients: the use of salt and brine—the former to be sowed with the seed, the latter to be poured on the plants; sowing flax with grains—a quart or two per acre—as being offensive to the chinch bug; and the sowing with each twelve bushels of winter wheat one bushel winter rye, and with spring wheat this proportion of winter wheat. The favorable effect reported from the use of salt is attributed to the invigoration of the plant. Reports of injury to stock feeding upon corn fodder badly infested with the bug are no doubt correct. (For recapitulation and matter not noticed here see previous entry.)

1876.

RILEY, C. V.—Insect Ravages. (St. Louis Globe-Democrat, Mar. 4, 1876.)

Loss by chinch bugs in Northwestern States in 1871, \$30,000,000; and in 1874, \$60,000,000.

REPORT DEPARTMENT OF AGRICULTURE, JULY, 1876. [Insect Injuries.] (Prairie Farmer, Aug. 19, 1876.)

Troublesome only in a few counties of the Northwest, including four counties in Wisconsin, three in Iowa, one in Missouri, one in Kansas, and Ogle and Winnebago in Illinois.

L., J. F.—Chinch Bugs, etc. (Prairie Farmer, Nov. 4, 1876.)

Thinks that by legislative action a fence could be secured around and through which fire might pass without injuring it, thus permitting the thorough destruction of leaves, weeds, and rubbish, which afford shelter to the chinch bug in the winter. Then, if concert of action could be secured, State Entomologist's suggestions might be carried out.

GLOVER, TOWNEND.—[The Chinch Bug or "Mormon Louse."] (Report of the Entomologist in Rept. [U. S.] Commiss. Agric. 1875, pp. 122, 123.)

Reports insect as injurious to almost every description of garden vegetables, grain, maize, herbs and other grasses, wheat, oats, potatoes, and even to buds of the pear and other trees. Describes the different stages, and on Dr. Shimer's authority mentions twenty days as the time occupied by the female in laying her eggs (about 500, deposited in ground, on or among roots of plants), which hatch in fifteen days. Two broods in Northern States; sometimes three in Southern. Hibernates under rubbish. One specimen taken in midwinter in Washington was one and a half inches under ground, stiff and lifeless when found, but soon as lively as ever. Insect multiplies much the fastest during dry seasons. Destroyed by several parasites. The false chinch bug and lace-wing flies said to destroy it, and quails to feed upon it.

GLOVER, TOWNEND.—Remedies Reported to be Serviceable in Destroying Insects of the Suborder Heteroptera, or Plant-Bugs. (Report of the Entomologist, in Rept. [U. S.] Commis. Agric. 1875, pp. 139, 140.)

Short general discussion of chinch-bug remedies with favorable mention of salt, sowing Hungarian grass with grains, ditching, and coal-tar barriers.

RILEY, C. V.—Lessons of the Year. (Eighth Rept. State Ent. Mo., 1875, pp. 142, 143.)

Says the destitution in western counties of Missouri the previous spring was certainly owing as much to the ravages of the chinch bug as to those of the locust. Mentions diversified agri-

culture as undoubtedly one of the most effectual means of counteracting its ravages. Recommends alternating grasses and cereals with root and forage plants not liable to injury by chinch bug.

UHLER, P. R.—List of Hemiptera of the Region West of the Mississippi River, including those collected during the Hayden Explorations of 1873. (Bull. U. S. Geol. and Geogr. Surv. of Terr's, v. 1, 2d ser., No. 2, p. 306.)

"Inhabits Texas, California, Kansas, Nebraska, Wisconsin, Minnesota, Illinois, Michigan, and generally throughout the Atlantic region.

"The short-winged form seems to be more common in New England than in the Southern States."

1877.

PRAIRIE FARMER, Feb. 3, 1877. Protect Useful Birds.

A farmer says, "Quails are known to eat chinch bugs by hundreds and thousands."

J[OHNSON], B. F.—Our Illinois Letter. (Cultivator and Country Gentleman, May 3, 1877, v. 42, p. 281.)

Some chinch bugs in Champaign County, April 24.

PRAIRIE FARMER, May 5, 1877.

Statement that farmers near Monroe, Wis., are going to sow flax with wheat and oats (about a peck to the acre) as a remedy for chinch bugs.

THOMAS, CYRUS.—Grasshoppers and Chinch Bugs. (Prairie Farmer, May 19, 1877.)

Little cause at present to apprehend damage by the chinch bug. A drought in the latter part of the summer may develop them in corn.

PACKARD, A. S., JR.—Insects Specially Injurious to Wheat, Oats, Barley, etc. (U. S. Geol. and Geogr. Surv. Terr's, 1875, pp. 697-699, figure 4, and map.)

"The most formidable enemy of wheat and corn." Found on summit of Mt. Washington and in Maine, but doubtless a southern and western insect. It probably inhabits the entire United States east of longitude 100°. Description of different stages; remedies.

1878.

J[OHNSON], B. F.—Our Illinois Letter. (Cultivator and Country Gentleman, May 23, 1878, v. 43, p. 325.)

Chinch bugs had begun to show themselves just before the heavy rains of the first week of this month, but were apparently drowned out.

THOMAS, CYRUS.—Insects Injurious to the Vegetable Garden. (Trans. Ill. State Hort. Soc., 1877, v. 11. p. 176.)

Chinch bug mentioned as often doing serious injury in the garden.

THOMAS CYRUS.—[Chinch Bug. *Blissus leucopterus*, Say.] (Seventh Rept. State Ent. Ill., 1877, pp. 5, 15-19, 40-71.)

No considerable appearance of chinch bugs since the scourge of 1874. They never occur in such overwhelming numbers as then except where two favorable years for their increase occur in succession, and the intervening winter is the time to apply the remedy. Refers to the verification of his predictions for 1876 and 1877 (comparative immunity from chinch-bug injury), and thinks the probabilities are that the insect will not prove injurious for a year or two. Estimates damage to the corn crop alone, in Illinois, in 1874, to be not less than \$20,000,000. Unquestionably the most formidable insect enemy of the Illinois farmer. Quotes descriptions of imago by Say and LeBaron; mentions its early appearance as recorded by Fitch, Say, and Harris; and gives account of the history of the species in Illinois, as recorded in various agricultural journals, including quotations from LeBaron's 2d Report,—1840 being given as the date of first appearance here in injurious numbers. Gives copy of circular of inquiry sent to various counties in 1875 concerning chinch-bug injury, number of broods observed, remedies used, etc., and gives quotations from replies received. Three broods are reported in a number of instances, and in Franklin county, "a small brood was produced in April,—an unprecedented event in the history of the chinch bug." (1) Descriptions of various stages and varieties. (2) Number of broods and hibernation: two-brooded, with some evidence of a third; hibernates in the adult stage, and appears in spring, from middle of March to May or June, according to latitude and character of season. (3) First brood hatch from eggs deposited by hibernating individuals, maturing in from five to seven weeks. (4) Migrations: Before the females of the first brood deposit their eggs they migrate,—almost always on foot and primarily in search of a more abundant food supply. Occasionally they take to flight, which is more common some years than others, depending largely on the weather and somewhat, perhaps, upon the time of their amours. (4) The natural agencies which assist in their destruction are lady bugs, lace-winged flies, the many-banded robber, quails, frogs, and rains,—the latter the chief natural agency which works against the chinch bug, destroying eggs, young, and adults. (5) The remedies mentioned are burning in winter quarters (corn stalks, straw, and other rubbish), drenching when practicable,—if fire cannot be used, and other measures as given in LeBaron's 2d Report (3d Rept. State Ent. Ill.), from which he quotes at length. [See ante page 58, 1872 LeBaron.] He agrees with LeBaron that topical applications as a check to the chinch bug are labor lost; says that fumigating is im-

practicable; but believes that when bugs attack corn "it is possible by great labor and expense to keep them down with hot water carefully applied." Clean farming the most hopeful measure.

UHLER, P. R.—Notice of the Hemiptera Heteroptera in the Collection of the late T. W. Harris, M. D. (Proc. Boston Soc. Nat. Hist., v. 19, 1876-1878, p. 392.)

Bibliographical references. Mention of localities where Harris's collections were made. His Massachusetts specimens, except one, short winged; those from Illinois with hemelytra and wings fully developed.

1879.

RILEY, C. V.—Entomological Notes. The Chinch Bug. (Farmers' Review, Feb., 1879.)

"Discusses weather influence, and advances parallel between Rocky Mountain locust and chinch bug; review of life history and summary of facts from Seventh Mo. Rept.; prediction of bugs in 1879 if weather prove dry." [Not seen. See Howard's Bibliographical List, Rept. [U. S.] Commis. Agric., 1887, p. 86.]

DAILY REPUBLICAN REGISTER [Galesburg, Ill.], June 9, 1879. Chinch Bugs.

In view of probable abundance of chinch bug editor urges close observation concerning it, and solicits reports on various points concerning its history, habits, etc.

CHICAGO TIMES, July 19, 1879.

A correspondent writes from Marion, Iowa, July 18: "The chinch bug is making sad ravages in the wheat fields of this section. Some farmers will not cut grain; others will secure about one fourth a crop."

1880.

THOMAS, CYRUS.—The Chinch Bug. Its History, Characters, and Habits, and the Means of Destroying it or Counteracting its Injuries. [Figures and Map showing distribution.] (Bull. U. S. Ent. Commission, No. 5, 1879. [Not issued until 1880.] Advance sheets, concerning amount of injury, published in Am. Ent., Feb., 1880, v. 3, p. 46; extract [The Chinch Bug. Its Winter Habits] in Am. Ent., Apr., 1880, v. 3, p. 85; and extracts in Globe-Democrat [St. Louis], Feb. 10, 1880; in Farmers' Review, Mar. 1, 1880; and in Prairie Farmer, Mar. 8, 1880.)

An exhaustive *résumé* of knowledge on the subject. Review of literature containing history of the pest from 1783 to 1877, with account of its destructiveness. Quotations from Say, Fitch, Le-Baron, Shimer, Riley, and others, with brief summary of his own article in the Seventh Illinois Report. Descriptions of all

stages (Riley's), and characters of nine varieties as pointed out by Fitch. Remedies, natural and artificial, considered at length, with quotations from Fitch and Riley laying particular stress upon drenching or irrigation as the best preventive measure where practicable. Statistical comparison of chinch-bug injuries to wheat and corn in Northwestern States, showing that corn sustained the greatest damage in the three great chinch-bug years, 1864, 1871, and 1874. Clean and diversified farming best methods of preventing increase. Entire loss to nation in 1874 estimated at \$100,000,000. "As the species seems to have a maximum of development about every five years," the annual loss to the nation is probably about \$20,000,000.

WELLS, T. C.—Notes from [Manhattan] Kansas. (Am. Ent., Mar., 1880, v. 3, p. 77.)

"Although we had a very wet season in 1878, and plenty of rain in 1879, the chinch bug continues troublesome, injuring spring wheat very materially, also millet, and where these are cut going for the corn. Some fields of corn were very badly damaged by them last season."

AMERICAN ENTOMOLOGIST, March, 1880, v. 3, p. 75.

"Prof. Cyrus Thomas has expressed the opinion that if we have a dry, early summer, the chinch bug will be very troublesome in the West the present year."

PACIFIC RURAL PRESS, May 8, 1880. The Chinch Bug.

Publishes query from Prof. Cyrus Thomas as to appearance of chinch bug on Pacific coast, answering in the negative, and quoting a paragraph from his recent article on the chinch bug (Bull. U. S. Ent. Commission, No. 5).

PRAIRIE FARMER, May 29, 1880. Chinch Bugs.

A letter from Ford Co., Ill., states that chinch bugs are abundant in small grain, and inquires if it should be plowed up to save the corn. Editors give extracts from Thomas's bulletin on the chinch bug.

PRAIRIE FARMER, July 17, 1880. [Answer to Correspondent.]

"If barley, winter or spring, is chinch-bug proof, we are not aware of it."

CARY, S. L.—Chinch Bug in Iowa and Minnesota. (Am. Ent., August, 1880, v. 3, p. 206.)

Writing July 1, says Northeastern Iowa and Southeastern Minnesota have been greatly infested with chinch bugs, which came as early as April, and were flying in great numbers about the 10th of June. They commenced laying eggs, but a wet spring and summer destroyed most of them.

THOMAS, CYRUS.—Temperature and Rainfall as Affecting the Chinch Bug.—Periodicity in its Increase. (*Am. Ent.*, Oct., 1880, v. 3, pp. 240-242.) Abstract of article, in *Prairie Farmer*, Sept. 10, 1881.)

Chronological data graphically represented by map showing relations of chinch-bug outbreaks in Illinois and adjoining portions of Iowa and Missouri, to weather conditions. Author began his investigations by ascertaining the annual average of rainfall from 1840 to 1877, and then noted the variation of each year from this average, representing these variations by curves. Taking this diagram as basis of discussion, calls attention to the fact that the series of years appears to be divided into cycles of seven. For example, counting backward from 1876 to 1840, the rainfall every seventh year seems to have been above the average, and this septenary period seems divided into periods of four and three years, the ternary period ranking first as to rainfall and the quaternary second. Next considers the relation of the rainfall to the appearance of chinch bugs, and regarding it as generally admitted that two successive dry years are necessary to the development of these insects in injurious numbers, he finds the chronological history of the species to be fairly conformable to his theory of periodicity. In closing he says, "The high temperature of 1854, '71, and '74, together with the diminished rainfall, furnish the key to the cause of the great development of the chinch bug during these years."

J[OHNSON], B. F.—Our Correspondence. (*Cultivator and Country Gentleman*, Oct. 28, 1880, v. 45, p. 692.)

Champaign Co., Oct 19. Losses from chinch bug this year are trifling, "but there are already indications that it will appear in force on next year's crops."

FORBES, S. A.—The Food of Birds. (*Bull. Ill. State Lab. Nat. Hist.*, v. 1, No. 3 (1880), pp. 113, 115, 121, 124.)

Chinch bugs were found in the food of the catbird and brown thrush, and in that of a single robin.

1881.

THOMAS, CYRUS.—Questions Answered. (*Prairie Farmer*, Jan. 8, 1881.)

Gives winter habits of chinch bug.

THOMAS, CYRUS.—Relation of Meteorological Conditions to Insect Development. (*Trans. Ill. State Hort. Soc.* 1880, n. s., v. 14, pp. 89-99.) [Shorter article under the same title (essentially an abstract of the above) in *Farmers' Review*, Jan. 13, 1881, v. 6, p. 30.]

Speaks of continual increase of insect enemies of agriculture due to extension of cultivation and to contact of cultivated areas. Accounts for oscillations of injurious insects by reference to

meteorological conditions, years of greatest drouth being generally marked by unusual development of insect life. Same cause renders plants less able than usual to withstand insect injury. Believes that as a rule two consecutive dry seasons are necessary to great development of most injurious species. Presents meteorological tables of rainfall and temperature for Illinois and adjacent parts of Iowa and Missouri from 1840 to 1877. Excludes Cairo record and early record from Sandwich, table being drawn from various sources not fully specified, but including Athens [Menard County] record, commencing in 1840, and signal service records of Chicago, Dubuque, Davenport, and St. Louis, for years 1873-77. Temperature series taken, with some exceptions, from Augusta, Hancock county. Concludes that a seven years' period is discernible in the rainfall series, each of these periods being again divided into sub-periods of four and three years respectively. Finds a passable correspondence between these periods and the years of greatest chinch-bug injury,—1850, 1854, 1871, and 1874. Infers that multiplication of chinch bugs depends on combined influence of increased rainfall and high temperature. Mentions some exceptions to this rule with their explanations. Belives it impossible to predict with certainty whether a given year will be marked by chinch-bug injury. Calls attention to an apparent error in the estimate of damage to the wheat crop by the chinch bug in 1864, made by Dr. Shimer, and of that to the crop of 1871, made by Dr. LeBaron. Says these estimates do not conform to the statistics of the Agricultural Department, and that they are entirely too large. Recommends planting trees and forming ponds as measures for retaining and distributing moisture in dry years.

THOMAS, CYRUS.—Anti-Chinch-Bug Crops. (*Farmers' Review*, Jan. 20, 1881, v. 6, p. 35.)

Answer to an inquiry from Nebraska as to the crops least subject to ravages by chinch bug, and the mode of farming best adapted to reduce its injuries to a minimum. As corn and spring wheat appear to favor the development of this insect more than other crops, reduce corn area and sow winter wheat. Favors the early sowing of buckwheat on land to be cropped in wheat, turning it under with the plow just before sowing wheat. Mentions flax and peas as crops little liable to injury by the chinch bug. Suggests four preventive measures: (1) Devote attention largely to stock-raising; (2) rely on winter wheat as chief money crop if it can be successfully grown, substituting oats for corn; (3) sow buckwheat, not only for grain but to clear ground of insects, raising also flax, peas, and potatoes, as far as profitable; (4) whenever the bugs appear in corn burn their hiding places in spring or fall—preferably in fall.

KINGSLEY, D. W.—Anti-Chinch-Bug Crops. (*Farmers' Review*, Feb. 24, 1881, v. 6, p. 114.)

Independence, Kan. "The ravages of the chinch bug here have been just in proportion to the wheat crop, especially on upland."

Saved corn after wheat was cut by plowing four furrows, four feet apart, and, with horses, dragging two logs or pig troughs in two furrows at a time. Saved the border rows of corn in one instance by use of hot water, pouring it on stalks with a cup. Did not hurt corn. Flax and castor beans about the only crops bugs will not trouble [?].

EVERETT, W. R.—Anti-Chinch-Bug Crops. (*Farmers' Review*, Mar. 3, 1881, v. 6, p. 131.)

Approves Dr. Thomas's recommendation to raise more stock, but objects to substituting winter wheat and oats for corn. Winter wheat winter-kills, and chinch bugs take oats. Advises raising corn and grass to feed to stock.

ILLINOIS CROP PROSPECTS. Consolidation of Reports returned to the Department of Agriculture June 1, 1881. Circular No. 76, pp. 4, 5. 14-37, 41.

For the "Southern Grand Division" of the State (including 41 counties) corn is reported as a very uneven stand, owing to drouth, poor seed, chinch bugs, army worms, and cutworms; and there are many complaints of injury to wheat, chinch bugs having contributed to it. They have also had some share in the reduction of the fall wheat crop throughout the State, and are reported in many counties as doing more or less damage to oats.

Correspondents' Remarks.—Cass, Champaign, Clay, Henry, Moultrie, Piatt, Richland, Schuyler, and Woodford Co's. Oats more or less damaged, but not seriously, and in Moultrie and Richland counties wheat nearly ruined by chinch bugs and Hessian fly. Bond, Clinton, Douglas, Edwards, Franklin, Menard, St. Clair, Stephenson, and White Co's. Much wheat plowed up and crop nearly ruined, the chinch bug, Hessian fly, and severe winter being jointly responsible except in Edwards, White, and Stephenson Co's, where no damage by Hessian fly is reported. Cumberland, Effingham, Fayette, Jackson, Jasper, Jefferson, Marion, Menard, Montgomery, Pike, Randolph, Sangamon, Shelby, Wabash, and Wayne Co's. Wheat very seriously damaged by chinch bug and Hessian fly, drouth contributing to the injury in Shelby, Wabash, and Wayne Co's. Hancock, Henderson, Macon, and McDonough Co's. Wheat very much injured by drouth and chinch bugs; yield of spring wheat reduced one half in county last named. Jersey, Knox, La Salle, Lawrence, Logan, and Tazewell Co's. Chinch bugs present in both fall and spring wheat, having in some instances done considerable injury. Hamilton Co. Nearly all fall wheat plowed up. Has had to contend with drouth, chinch bug, Hessian fly, and, in some localities with rust. Madison Co. Hessian fly and chinch bug have done more damage to wheat on prairie soil than on timber land. Massac Co. Many fields of wheat destroyed by army worm and chinch bug.

FARMERS' REVIEW. REVIEW OF THE SEASON.

June 2, 1881, v. 6, p. 340. *Crawford and St. Clair Co's.* Winter wheat very nearly a failure on account of chinch bug and Hessian fly. *Clinton Co.* Winter wheat less than half a crop. Cause, chinch bug, fly, and winter killing. *Marion Co.* Chinch bugs working in the wheat. *Shelby Co.* Wheat an entire failure. June 9, 1881, p. 356. *Clay, Fayette, and Shelby Co's.* Wheat greatly reduced, half crop, or failure, on account of chinch bug and Hessian fly. *Clinton Co.* Wheat badly injured by army worm and chinch bug. *Cumberland Co.* Winter wheat almost destroyed. *Grundy Co.* Dry weather has developed chinch bugs. *Henderson and La Salle Co's.* Appearing in great numbers. *Henry Co.* In oats. Farmers sowing one and one half bushels of salt to the acre to stop their work. *Jasper Co.* Winter wheat will be less than half a crop. June 23, 1881, v. 6, p. 388. *Lawrence Co.* Wheat damaged by chinch bug and fly. *Wayne Co.* Wheat nearly ruined by chinch bug and Hessian fly. June 30, 1881, pp. 404, 409. *Bond and Jefferson Co's.* Chinch bugs in some localities. *Clay Co.* Chinch bugs bad. *Clinton Co.* Beginning work on corn. *Crawford Co.* Winter wheat damaged considerably. *Perry Co.* Numerous in corn. *Kendall Co.* Drouth developed the chinch bug in many localities. July 7, 1881, p. 420. *Clinton Co.* Wheat damaged by Hessian fly and chinch bug. *Fulton Co.* In some fields of wheat, but no general complaint. *Kendall Co.* Corn damaged by drouth and chinch bug. July 21, 1881, p. 36. *Bond Co.* In both corn and oats. *Clay Co.* Doing much damage. *Cumberland Co.* Winter wheat nearly a failure on account of chinch bug and Hessian fly. Bugs hurting the corn. *Mower Co.* Damaging small grain. *Olmsted Co.* Will take most of the wheat. *Sangamon Co.* Winter wheat greatly reduced. July 28, 1881, p. 52. *Bond and Washington Co's.* Very destructive to corn. *Clinton Co.* Injuring wheat. *Sangamon Co.* Doing damage locally. *Tazewell Co.* Heavy rains killed most of the chinch bugs. Aug. 4, 1881, p. 68. *Adams Co.* Oats and late corn damaged. *Calhoun Co.* Wheat injured by chinch bug, Hessian fly, and winter. *Lawrence, Stark, and Wabash Co's.* Corn seriously damaged. Aug. 11, 1881, p. 84. *Bond, Crawford, and Wayne Co's.* Dry weather and chinch bugs have ruined much corn. *Clay Co.* Corn an entire failure on account of drouth and chinch bugs. *DeWitt, Grundy, Macoupin, and Moultrie Co's.* Corn suffering from drouth and chinch bugs. *Hamilton Co.* Chinch bugs reported. Aug. 18, 1881, p. 100. *Clinton, Crawford, Effingham, Jasper, Jackson, Sangamon, Washington, Wayne, White, and Williamson Co's.* Corn nearly or quite ruined by chinch bugs and drouth,—the latter not mentioned, however, for Clinton county, and only early-planted corn for Sangamon. Sept. 1, 1881, p. 132. *Clinton, Crawford, and Edwards Co's.* Corn nearly or quite ruined by drouth and chinch bugs. Sept. 8, 1881, p. 148. *Jackson Co.* Early corn injured by bugs and drouth. Sept. 22, 1881, p. 180. *Jefferson Co.* Drouth and chinch bugs ruined corn. Sept. 29, 1881, p. 196. *Henry Co.*

Corn half a crop; bugs, poor seed, and late spring. *Logan Co.* Ground very dry and corn full of bugs. Oct. 6, 1881. *Madison Co.* Too dry and too many chinch bugs to sow wheat. Nov. 17, 1881, p. 309. *Hardin Co.* Corn but two thirds crop on account of drouth and chinch bugs. *Macon Co.* Corn injured more by chinch bugs than by drouth.

INDIANA.—Aug. 18, 1881, p. 100. *Ohio* and *Posey Co's.* Chinch bugs and dry weather. Corn cut short in latter county.

IOWA.—June 2, 1881, v. 6, p. 340. *Cerro Gordo Co.* Unusual number of chinch bugs in wheat. *Howard Co.* Chinch bugs present. June 16, 1881, p. 372. *Butler, Des Moines, and Wayne Co's.* Wheat infested. *Fayette Co.* Chinch bugs appearing. June 23, 1881, p. 388. *Floyd, Labette, Miami, and Republic Co's.* Injuring wheat. July 7, 1881, p. 420. *Chickasaw, Hardin, and Jefferson Co's.* Dry weather and chinch bugs reported injurious. July 14, 1881, p. 20. *Appanoose, Butler, Dallas, Fayette, Floyd, and Franklin Co's.* More or less abundant and injurious in wheat. July 21, 1881, p. 36. *Delaware, Hardin, and Keokuk Co's.* Very destructive to spring wheat. July 28, 1881, p. 52. *Adair, Black Hawk, and Chickasaw Co's.* Chinch bugs doing much damage. *Benton Co.* Army worms and chinch bugs in spring wheat. Aug. 4, 1881, p. 68. *Butler, Cerro Gordo, Floyd, Guthrie, Hamilton, Jefferson, Mahaska, Mitchell, Taylor, Union, and Winneshiek Co's.* Spring wheat much injured; almost a failure in some localities. Aug. 11, 1881, p. 84. *Appanoose Co.* Heavy damage to rye and wheat. *Benton Co.* Serious injury to wheat. Aug. 18, 1881, p. 100. *Clayton Co.* Spring wheat a failure on account of chinch bugs and rust. *Floyd Co.* Spring wheat badly injured by blight and chinch bugs. Aug. 25, 1881, p. 116. *Fayette Co.* Spring wheat destroyed.

KANSAS.—June 2, 1881, v. 6, p. 340. *Franklin and Neosho Co's.* At work; but heavy rains have stopped their breeding. *Miami Co.* Much wheat plowed up on account of chinch bugs. *Woodson Co.* Wheat damaged fifty per cent. by drouth and chinch bugs. June 23, 1881, p. 388. *Elk Co.* Winter wheat badly injured. June 30, 1881, p. 404. *Jefferson and Labette Co's.* Chinch bugs reported. June 30, 1881, p. 409. *Harvey Co.* The ground is well soaked, but chinch bug doing much damage notwithstanding. Half of the wheat gone and issue of corn crop doubtful. July 7, 1881, p. 420. *Coffey, Clay, Harvey, Marshall, Neosho, Osage, Republic, and Woodson Co's.* More or less serious damage to wheat by chinch bugs and drouth, sometimes amounting to loss of half the crop. July 21, 1881, p. 36. *Atchison Co.* In corn. *Chase, Ellis, Republic, and Trego Co's.* Winter wheat seriously damaged. July 28, 1881, pp. 52, 56. *Atchison, Chautauqua, Crawford, and Ellsworth Co's.* Yield of winter wheat much reduced. *Jefferson Co.* Corn damaged by chinch bugs and dry weather. *Jewell Co.* Winter wheat and some spring wheat a failure. Hundreds of acres of corn destroyed by drouth and chinch bugs. *Barton Co.* Chinch bugs and drouth have injured late-sown wheat at least

one half. Aug. 4, 1881, p. 68. *Lincoln, Linn, Neosho, Osborne, Ottawa, Rooks, Russell, and Saline Co's.* Wheat more or less damaged, injury varying locally from five to fifty per cent. *McPherson and Mitchell Co's.* Corn damaged. *Sheridan Co.* Much winter wheat destroyed. Aug. 11, 1881, p. 84. *Cherokee Co.* Winter wheat cut short. *Neosho and Saline Co's.* Corn injured by drouth and chinch bugs. Sept. 1, 1881, p. 132. *Cloud, Cherokee, Elk, Johnson, Labette, and Republic Co's.* Corn very seriously damaged. Sept. 29, 1881, p. 196. *Woodson Co.* Owing to countless number of chinch bugs, there will be little wheat sown. Oct. 6, 1881, p. 212 or 217. *Elk Co.* (Sept. 26). Late corn injured. Chinch bugs flying yesterday.

MINNESOTA.—June 9, 1881, p. 356. *Olmsted and Wabasha Co's.* Chinch bugs present. June 23, 1881, p. 388. *Goodhue Co.* Chinch bugs numerous, but no harm done yet. *Houston Co.* Numerous. July 7, 1881, p. 420. *Dakota Co.* Some chinch bugs in spring wheat. *Wabasha Co.* Chinch bugs numerous. July 14, 1881, p. 20. *Dakota and Washington Co's.* A few in wheat. *Fillmore, Mower, Olmsted, and Rochester Co's.* Very abundant. *Houston Co.* Millions in the wheat. July 28, 1881, p. 52. *Fillmore, Goodhue, and Houston Co's.* Spring wheat damaged. Aug. 4, 1881, p. 68. *Dakota, Dodge, Fillmore, Goodhue, Houston, Isanti, and Mower Co's.* Spring wheat very seriously damaged. Aug. 11, 1881, p. 84. *Fillmore Co.* Wheat somewhat injured. Aug. 18, 1881, p. 100. *Dakota Co.* Wheat injured by drouth, blight, and chinch bug. *Houston Co.* Spring wheat almost destroyed by chinch bugs. Aug. 25, 1881, p. 116. *Mower Co.* Corn damaged by drouth and chinch bugs. Sept. 1, 1881, p. 132. *Olmsted Co.* Some corn injured by drouth and chinch bugs.

MISSOURI.—June 2, 1881, v. 6, p. 340. *Bates Co.* Winter wheat seriously damaged. *Howard and La Fayette Co's.* Chinch bugs present. June 23, 1881, p. 388. *Cass and Cooper Co's.* Have done great damage. June 30, 1881, p. 404. *Boone Co.* Some chinch bugs in corn. July 7, 1881, p. 420. *Cass and Clay Co's.* Damaging wheat and late corn. July 21, 1881, p. 36. *Boone Co.* Corn suffering for rain, and hundreds of acres ruined by chinch bugs. *Marion Co.* Corn doing finely; chinch bugs very bad. July 28, 1881, p. 52. *Benton Co.* Winter wheat and corn injured. Aug. 18, 1881, p. 100. *Bates, Bollinger, Franklin, Jackson, Jasper, Kearney, Miller, Newton, St. Francois, Saline, and Worth Co's.* Damage to corn by drouth and chinch bugs fifty per cent. to total loss.

NEBRASKA.—July 21, 1881, p. 36. *Franklin, Hall, and Merrick Co's.* Damaging spring wheat locally. *Hamilton Co.* Doing great damage. July 28, 1881, p. 52. *Burl, Clay, Merrick, and Hamilton Co's.* Presence of chinch bug reported. *Cass Co.* Wheat damaged. *Jefferson Co.* Late wheat taken. Aug. 4, 1881, p. 68. *Cass, Fillmore, Furnas, Franklin, Jefferson, Merrick, Oloo, Platte, Pawnee, Saline, Saunders, Thayer, Washington, Webster, and York Co's.* Very destructive to spring wheat.

WISCONSIN.—June 9, 1881, p. 356. *Brown Co.* Barley damaged. *Dane* and *Dodge Co's.* Chinch bugs at work. June 23, 1881, p. 388. *Trempealeau Co.* Numerous, but doing no damage yet. July 7, 1881, p. 420. *Columbia Co.* On spring wheat. No injury yet. July 21, 1881, p. 36. *Clark Co.* Some chinch bugs. Aug. 4, 1881, p. 68. *Chippewa Co.* Spring wheat more or less injured by "insects." *Clark* and *Pierce Co's.* Chinch bugs reported. *Columbia, Crawford, Dodge,* and *Juneau Co's.* Spring wheat badly damaged. *Dane, Dunn, Jackson,* and *Monroe Co's.* Spring wheat injured. Aug. 25, 1881, p. 116. *Columbia Co.* Spring wheat injured by blight, rust, and chinch bugs. *Dunn Co.* Spring wheat almost ruined by chinch bugs. Sept. 22, 1881, p. 180. *Pepin Co.* Chinch bugs damaged corn more than the drouth.

PRAIRIE FARMER, June 5, 1881. The Chinch Bugs.

Notice of appearance in Illinois, and methods of preventing migrations quoted from Thomas: (1) Plowing narrow strip around field, keeping soil well pulverized by harrowing and rolling, and then plowing furrows in this dusty strip; (2) ditching,—care being taken to have side next to field perpendicular.

J[OHNSON], B. F.—The Potato Beetle, the Chinch Bug, and the Hessian Fly. (Home and Farm, June 15, 1881.)

These insects have appeared in large numbers, as always after a hot, dry season followed by a long, cold winter—cold doing them no harm unless associated with moisture. Fight chinch bugs by burning rubbish, and prevent migration by furrows filled with straw, and fired; or sprinkle a solution of Paris green [?] on outer rows of corn attacked.

FARMERS' REVIEW, June 16, 1881, v. 6, p. 376. The Wheat Outlook.

INDIANA.—Winter wheat will not be much more than half a crop, owing to hard winter, Hessian fly, and chinch bug.

MINNESOTA.—Hessian fly and "bug" have injured spring wheat in some counties, but prospect good.

MISSOURI.—Winter wheat has been badly damaged by drouth, fly, and chinch bug.

FARMERS' REVIEW, June 23, 1881, v. 6, p. 392. Illinois Corn. Prospects of the growing Crop.

In the "Southern Grand Division" of the State (41 counties) there is much complaint of the corn crop's being injured by drouth, chinch bugs, army worms, and cutworms.

MOSELY, HENRY C.—War against Insects. (Farmers' Review, July 21, 1881, v. 7, p. 34.)

Mention of three farmers in Hancock county who prevented chinch bugs' going from wheat and rye to corn by use of coal-tar in a furrow, with pits dug at intervals.

FARMERS' REVIEW, July 21, 1881, v. 7, p. 41. The Chinch-Bug Pest.

Complaint concerning chinch-bug injuries to wheat more widespread than for many years. Principal damage done on old lands. Editor recommends fertilizers. Mentions a field exhausted by nearly fifty years' cultivation, which was in part fertilized with barn-yard manure and slight admixture of wood ashes and plaster. On fertilized portion, wheat unusually thrifty and free from insects; on unfertilized, thin and sickly, insects wholly destroying it before harvest-time. "They never attacked the grain on the manured land, though the pieces were only divided by the furrow up to where manure had been applied." Proprietor said he had never seen chinch bugs or Hessian fly in wheat where nitrogenous fertilizers had been freely applied. Thinks insects are seldom troublesome until soil has lost a large percentage of nitrogen and phosphates. Considers these properties objectionable to the insects.

MOSELY, HENRY C.—From Central Illinois. (Farmers' Review, Aug. 4, 1881, v. 7, p. 73.)

Notes the mistake of a farmer who, after plowing under in spring a piece of fall wheat devoured by the chinch bugs, planted the land to corn and lost that. Better plan to have sowed buckwheat.

FARMER AND FRUIT GROWER, Aug. 17, 1881. Perry County Crops.

For fifty years has not been such an utter failure of crops as this season. Drouth and chinch bugs.

THOMAS, CYRUS.—Crop Destroyers: The Corn Worm, Chinch Bug, and Army Worm. (Farmers' Review, Aug. 18, 1881.)

Mention of verification of his chinch-bug predictions for 1881. "Although our farmers have suffered severely by this verification, it may be of value to them in the future, as it is additional evidence of the correctness of my statement that chinch bugs will only appear generally and in injurious numbers where two dry years appear in succession, the latter being above the ordinary temperature. If my warnings had been heeded, and farmers had relied upon oats instead of corn for stock provender, a very large saving would have been the result."

PRAIRIE FARMER, Aug. 20, 1881. The Chinch Bug.

Editorial note of present serious injuries in the West, with compiled account of history and life history of the chinch bug.

THOMAS, CYRUS.—Corn Worms, Chinch Bugs, Hessian Fly. (Prairie Farmer, Aug. 20, 1881.)

Reference to his advice to sow oats instead of corn, and the benefit that might have resulted if it had been regarded. After the appearance of the bugs, irrigation the only way of destroying them without destroying the crop,—and that is very seldom practicable.

J[OHNSON], B. F.—[Letters from Champaign County, Illinois, in Farmers' Review.]

Aug. 25, 1881, v. 7, p. 121. "In case rain enough does not fall between this time and October 15, the chinch bugs will be pretty sure to take the new crop of wheat as soon as it is above the ground, as they did in the fall of 1874. * * * I suggest that rye be sown in the place of wheat, for the several reasons that it is comparatively indifferent to a dry seed-bed, may be sown any time in October, repels the chinch bug[?], and will not be injured by any amount of cold and dry weather." Sept. 15, 1881, p. 169. Corn full of chinch bugs whether near small grain stubbles or remote. Recently saw them flying in swarms. Predicts injury to fall wheat if sown early. [Also in *Prairie Farmer*, Sept. 17, 1881.] Oct. 20, 1881, p. 249. Wheat doing well, the chinch bugs having been greatly reduced in number; but corn was in poor condition to stand two or three weeks of rain at high temperature, having been dwarfed by late planting and drought and the sap-sucking chinch bugs.

BUSH, J. G.—The F. R. Club. Morgan and Scott Counties. (*Farmers' Review*, Sept. 8, 1881, v. 7, p. 153.)

With the general unfavorable weather and chinch bugs, it is a wonder that crops are so good as they are.

FRENCH, G. H.—Katyids vs. Chinch Bugs: (*Prairie Farmer*, Sept. 17, 1881.)

Quotes a respectable farmer as authority that Katyids eat chinch bugs.

RILEY, C. V.—The Chinch Bug. (*American Naturalist*, October, 1881, v. 15, p. 820.)

The connection between meteorological conditions and the increase or decrease of the chinch bug, has long been recognized by entomologists. Generalizing from chronological data on this point, Prof. Thomas, a year ago, predicted that the insect would probably be bad in 1881. The recent chinch-bug convention at Windsor, Kansas—the first ever held in the United States—is evidence of the disastrous character of its ravages in the West. A large number of farmers were present and adopted a resolution to abandon the culture of wheat for a time. It would have been well for the farmers of that region if they had heeded the recommendation of Prof. Thomas that this year large areas of oats be sown. The chinch bug has been quite common in all parts of the country the present season. In August it injured rice fields near Savanna, Georgia; and in July was noticed in great numbers on "sand-oats" and other grasses on the dunes of Fortress Monroe, Virginia.

THOMAS, CYRUS.—Insects injuring Field Crops. (*Farmers' Review*, November 24, 1881, vol. 7, p. 322.)

Corn sustained heavy damage by drouth, but chinch bugs have increased it. Twenty-five years' experience shows that in Illinois the chinch bug is the greatest insect foe of corn, injuring it more than all other species combined. It cannot be checked by applications of any kind. This can only be done by radical changes in methods of cropping. In the middle and southern sections of the State the best plan is to plant less corn; and the next best thing is to utilize our meteorological records, ascertaining by this means, with reasonable certainty, the general character of the coming year. Refers to the verification of his prediction of a dry season in 1881 and the probable appearance of the chinch bug, as indicating the discovery of a meteorological law applicable at least to Illinois. Farmers will consequently need to crop against this insect only in such years as it is likely to appear. Predicts no great trouble on account of it in 1882 or for three or four years following. Quotes conclusions from Dr. Le Baron's Second Report as State Entomologist of Illinois, saying, however, that he thinks Dr. Le Baron overestimates the damage done to wheat by this pest, and that his conclusion that "the presence of chinch bugs the preceding year will not prevent the raising of corn or any of the winter grains" is not applicable to the more northern section of the State.

RILEY, C. V.—The Chinch Bug. (*American Agriculturist*, November and December, 1881, pp. 476, 515, figs. 1, 2, 3, and 1, 2, 3, 4.)

Very seriously injurious in the grain-growing sections of the Mississippi Valley the past season. An indigenous American insect, thriving best in southerly latitudes and in a warm dry climate. In estimating its injury it is difficult to eliminate that due to drouth alone, but careful computations show that the loss by the chinch bug in Illinois and Missouri in 1874 amounted to about \$50,000,000. Feeds exclusively on grasses and cereals, and by suction. Short description, with sketch of habits and natural history. Heavy rains, wet seasons, and warm, moist, or open winters very prejudicial to it. Natural enemies are few and afford but a slight check upon it. Ants (which destroy eggs) and some of its nearer relatives among the half-winged bugs are mentioned as perhaps most efficient among insect enemies, and the quail is said to be prominent among the few birds that feed upon it when hard pushed for food. Figures of the insidious flower bug, the many-banded robber, the false chinch bug, and the ash-gray leaf bug given, as they are often mistaken for the chinch bug—the latter also figured. Summary of direct remedies from 7th Missouri Report. The value and general practicability of irrigation as a destructive measure emphasized. Burning in winter quarters next in importance as a remedy. Sow spring wheat early and roll ground. Winter wheat may also be rolled, but early sowing of this would increase liability to injury by Hessian fly. Sow thickly

to shade ground, thus increasing moisture. If in late winter the bugs are known to be numerous, it will be well to sow no spring wheat or barley. The chinch bug will be harmless in proportion as an intelligent and cleanly system of agriculture is adopted.

ILLINOIS CROPS FOR 1881. Circular No. 82 [of the Dept. of Agriculture], pp. 4, 58-71, 103.

Table showing effects of drouth and chinch bugs on yield of corn. Wheat and corn seriously injured in Central and Southern Illinois.

Correspondents' Remarks.—Adams, Calhoun, Christian, Gallatin, and Woodford Co's. Wheat and corn more or less seriously injured. Alexander, Champaign, Effingham, Mason, Morgan, and St. Clair Co's. Much damage by chinch bug. Bond Co. Fall rains nearly destroyed them. Brown, Carroll, Clark, Douglas Grundy, Hancock, Henderson, Lake, Livingston, Logan, Macoupin, Marshall, Menard, Mercer, Monroe, Peoria, Pike, Rock Island, Scott, Shelby, and Tazewell Co's. Corn damaged. Bureau, Jo Daviess, La Salle, and Moultrie Co's. Oats and corn more or less damaged. Clay, Clinton, Fayette, Franklin, Jasper, Jefferson, Lawrence, Marion, Perry, Richland, Wayne, and Washington Co's. Corn a failure because of bugs and drouth, and wheat also injured in Washington Co. Coles, Crawford, Hardin, Jersey, Massac, Montgomery, Wabash, and Williamson Co's. Corn nearly a failure, or much, or considerably injured. Cook Co. Yield of spring wheat reduced. Cumberland, Greene, Henry, Johnson, Randolph, Sangamon, Union, and Warren Co's. Corn much damaged. Iroquois Co. Chinch bugs very numerous. Kankakee Co. Chinch bugs and white grubs did considerable damage to corn, wheat, and rye. Fulton and Kendall Co's. Corn, spring wheat, and oats damaged. Knox Co. Corn, rye, oats, and spring wheat damaged more than usual. McDonough Co. Late corn injured by the chinch bugs. Hessian fly, army worm, and chinch bugs damaged crops more than for years previous. White Co. Some wheat injured in fall.

CASE, F. W.—The Chinch Bug—*Blissus leucopterus*. (Trans. Wis. State Agric. Soc. 1880-81, pp. 441-450.)

A compiled article giving account of injuries, life history, and remedies.

MENDENHALL, R. E.—Entomology. (Trans. Minn. State Hort. Soc., 1881, p. 78.)

Chinch bugs appeared in considerable numbers in Southeastern Minnesota, but June rains prevented serious damage "except in some localities."

Encouraging experience in applying salt to wheat. Thinks that the salt has a cooling influence upon the root, delaying the ripening of the grain and the exhaustion of the sap. A narrow strip

the whole length of the field, where salt was not sown, contained more chinch bugs than all the rest of the field, and bore only about half as much wheat per acre.

RILEY, C. V.—*Micropus leucopterus*. (General Index and Supplement to the Nine Reports on the Insects of Missouri. Bull. No. 6, U. S. Ent. Commiss., p. 58.)

“Now referred to Burmeister’s genus *Blissus*.”

SAUNDERS, WM.—Annual Address of the President of the Entomological Society of Ontario. (Canadian Entomologist, 1881, v. 13, p. 198; Rept. Ent. Soc. Ontario, 1881, p. 5.)

Mention of serious chinch-bug injuries to corn in Missouri and Kansas and comparative immunity from them in Ontario.

FARMERS’ REVIEW, ——— 1881. [Starving out the Chinch Bug.]

Editors note that farmers in vicinity of Windsor, Ottawa Co., Kan., have resolved to starve out the chinch bug, having, in convention, voted to abandon the growing of spring wheat for a series of years.

EVERETT, W. R.—The Chinch Bug. (Farmers’ Review, ——— 1881 [?].)

Writes from Caldwell Co., Mo., that last August, at a meeting for consultation, farmers at Windsor, Henry Co., Mo. [?], agreed not to sow any wheat last fall. Wheat raising has been abandoned “in this part of Missouri on prairie lands, and the bugs are not so bad as when more wheat was sown. If Prof. Thomas’s theory is correct the farmers ought to quit raising corn instead of wheat.”

1882.

PRAIRIE FARMER, Feb. 11, 1882. Chinch Bugs in Kansas.

Chinch bugs swarming in prairie grass. Various remedial measures briefly discussed. Probably the best course is to grow other crops than wheat and barley for at least two years in a district that has been infested.

FORBES, S. A.—The Ornithological Balance Wheel. (Trans. Ill. State Hort. Soc., 1881, v. 15, p. 130; Trans. Ind. Hort. Soc., 1881, p. 80.)

Fifteen representatives of eight species of birds shot among the chinch bugs had not eaten these insects at all; but one catbird, three brown thrushes, and one meadow lark were previously found to have eaten them in barely sufficient number to show that they have no unconquerable prejudice against them.

FARMERS’ REVIEW. FARMERS’ REVIEW OF THE SEASON, AND F. R. CLUB RECORD.

March 30, 1882, v. 8, Supplement, p. 3. *Efingham Co.* Some chinch bugs. *Madison Co.* County full of them. April 6, 1882, p. 212. *Coles Co.* Chinch bugs flooded out. *Shelby Co.* Chinch

bugs plenty. No damage yet. April 13, 1882, p. 228. *Alexander and Macon Co's.* Chinch bugs have appeared. *Douglas Co.* Plenty, but doing no damage. *Fayette and Hancock Co's.* Numerous. April 20, 1882, p. 244. *Cumberland, Jersey, Lawrence, and Washington Co's.* Chinch bugs reported as more or less numerous. April 27, 1882, p. 260. *Crawford, Cumberland, Ford, Logan, Macoupin, McDonough, Montgomery, Fayette, Franklin, Gallatin, Hardin, Johnson, Richland, Jefferson, and Union Co's.* Plenty of chinch bugs; but wheat "splendid" in Ford county. May 4, 1882, pp. 276, 281. *Brown, Christian, Cass, Gallatin, Macon, Piatt, Pike, and Richland Co's.* Chinch bugs still alive. *Crawford, Effingham, Fayette, Hamilton, Iroquois, McDonough, McLean, Marion, Mason, Monroe, St. Clair, and Vermilion Co's.* Numerous. *Greene and Massac Co's.* Doing damage. *Madison Co.* Flying every day. *Morgan Co.* Not yet destroyed by rains. *Randolph Co.* Rains have destroyed most of the chinch bugs. *Jasper Co.* Present, but doing little injury. May 11, 1882, p. 292. *Cass, Clay, Clinton, Coles, Crawford, DeWitt, Douglas, Edwards, Fulton, Jefferson, Johnson, Logan, Morgan, Moultrie, Perry, Pike, Saline, Shelby, and White Co's.* Chinch bugs more or less numerous, but no injury mentioned except in Saline county, where they are said to be injuring wheat. In Morgan county, wheat never better. May 18, 1882, p. 308. *Christian, Clinton, Coles, Cumberland, Fayette, Greene, Johnson, Logan, Montgomery, Sangamon, and Wabash Co's.* Chinch bugs numerous. In Sangamon county, on the wing. *Calhoun and Jasper Co's.* Have made their appearance. *Franklin, Madison, and White Co's.* Wheat is being seriously injured. *Macoupin and Shelby Co's.* Still alive. Doing no damage in Shelby county. *Mason and Wayne Co's.* Wheat too far advanced to be injured. *Monroe Co.* Fear wheat will be injured. May 25, 1882, p. 324. *Crawford, Douglas, Effingham, Fayette, Fulton, Gallatin, Jersey, Logan, Lincoln, Macon, Madison, Mason, St. Clair, and Shelby Co's.* Chinch bugs reported as "plenty" or "numerous," wheat being already damaged in Gallatin county. *Hardin Co.* Chinch bugs here. June 1, 1882, p. 340. *Brown, Monroe, Peoria, Sangamon, and St. Clair Co's.* Chinch bugs damaging wheat. *Coles, Cumberland, Clark, Edgar, Macoupin, Macon, and Morgan Co's.* More or less numerous, but damage not reported. *Fulton, Jersey, and Scott Co's.* Wet or cold weather keeping chinch bugs back. *White Co.* Wheat too far advanced for injury. June 8, 1882, pp. 353, 360. *Christian Co.* Chinch bugs checked by heavy, chilly rains. *Crawford, Fayette, Gallatin, Greene, Hamilton, Randolph, Saline, and Wabash Co's.* Damage to winter wheat by chinch bug, but army worm contributing to the loss in most cases reported. *Franklin, Jersey, Madison, and St. Clair Co's.* Chinch bugs and army worms plenty. *Pulaski Co.* Millions of chinch bugs at work. *Union Co.* Chinch bugs plenty. June 15, 1882, p. 372. *Jasper Co.* Cold weather destroyed chinch bugs. *Livingston Co.* Wet weather has quieted chinch bug. June 22, 1882, p. 388. *Calhoun, Edwards, and Hamilton Co's.* Wheat damaged some by

chinch bugs and army worms. *Shelby Co.* Chinch bugs would do much damage if weather should turn hot and dry. June 29, 1882, p. 409. *Christian and Piatt Co's.* Chinch bugs in corn. In the latter county hatching of young prevented by cold rains. July 6, 1882, p. 417. *Champaign Co.* Chinch bugs have appeared in the broom-corn fields in great force. July 6, 1882, p. 425. *Champaign Co.* Corn, broom-corn, and sorghum threatened. *Scott Co.* (June 12). Chinch bugs doing little harm. July 13, 1882, p. 20. *Pike Co.* Thick in wheat. July 20, 1882, p. 36. *Greene Co.* Hay average crop; much destroyed by chinch bugs. July 27, 1882, pp. 52, 57. *Jersey and Knox Co's.* Chinch bugs reported. *Piatt Co.* Corn crop likely to fail if dry weather and chinch bugs continue long.

INDIANA.—April 13, 1882, p. 228. *Posey Co.* Chinch bugs abundant. April 20, 1882, p. 244. *Greene Co.* Chinch bugs present, but no damage. April 27, 1882, p. 260. *Sullivan Co.* Chinch bugs still alive. May 11, 1882, p. 292. *Greene Co.* Numerous. May 18, 1882, p. 308. *Gibson, Posey, Rush, and Vigo Co's.* Some chinch bugs. Injuring wheat and corn in Posey county. May 25, 1882, p. 324. *Posey Co.* Chinch bugs have appeared in great numbers. June 1, 1882, p. 340. *Greene Co.* Chinch bugs plenty. *Vigo Co.* Very few. June 8, 1882, p. 353. *Greene Co.* Damaged winter wheat. June 22, 1882, p. 388. *Du Bois Co.* Chinch bugs here, but doing no harm.

IOWA.—June 22, 1882, p. 293. *Benton Co.* Millions of chinch bugs in some fields of rye. June 29, 1882, p. 404. *Adair, Mills, and Taylor Co's.* Chinch bugs doing more or less damage to spring wheat. *Linn Co.* Some chinch bugs. *Wayne Co.* Chinch bugs in oats. July 6, 1882. *Howard, Marion, Tama, Taylor, and Wapello Co's.* Chinch bugs numerous. July 13, 1882, p. 20. *Cedar, Clinton, DeWitt, Des Moines, Guthrie, Henry, Mills, Poweshiek, Tama, and Wapello Co's.* Chinch bugs reported as more or less numerous. No serious damage. July 20, 1882, p. 36. *Butler, Benton, Floyd, Franklin, and Pottawattamie Co's.* Chinch bugs reported. July 27, 1882, p. 52. *Dubuque, Howard, Jefferson, and Johnson Co's.* Chinch bugs more or less numerous. Aug. 3, 1882, p. 68. *Floyd Co.* Some bugs in spring wheat. Aug. 10, 1882, p. 84. *Cerro Gordo and Floyd Co's.* Some complaint of chinch bugs. Aug. 17, 1882. *Butler, Hardin, and Winneshiek Co's.* Chinch-bug injuries reported.

KANSAS.—Apr. 20, 1882, p. 244. *Butler, Chautauqua, Dickinson, and Lincoln Co's.* Presence of chinch bugs reported. Apr. 27, 1882, p. 260. *Jefferson, Lyon, and Rush Co's.* Chinch bugs reported, and great destruction feared in Lyon county. *Elk Co.* Chinch bugs swarming in the air. May 4, 1882, p. 276. *Bourbon, Cherokee, Greenwood, Jefferson, and Labette Co's.* Chinch bugs numerous; in latter county swarming. Wheat good in Jefferson county. *Coffey Co.* No damage. Probably rains have destroyed the bugs. *Harvey and Lincoln Co's.* More or less numerous. May 11, 1882, pp. 292, 297. *Atchison, Crawford, Ellis,*

Franklin, Jefferson, Lyon, Miami, Phillips, Republic, Riley, Stafford, and Wilson Co's. Chinch bugs more or less numerous. In Phillips county they have been nearly destroyed by cool weather. *Elk Co* (Apr. 27). "Chinch bugs injuring early corn and oats. Some wheat has been plowed up." May 18, 1882, p. 308. *Anderson, Bourbon, Butler, Davis, Douglas, Greenwood, and Rush Co's.* Chinch bugs numerous; but in Douglas county no damage. *Coffee and Ellis Co's.* Chinch bugs here. *Morris Co.* Thick on fall wheat. *Pawnee Co.* A few in winter wheat. May 25, 1882, p. 324. *Butler, Cherokee, Coffey, Jefferson, Lyon, Leavenworth, Republic, Reno, Saline, and Sumner Co's.* Chinch bugs very numerous, threatening to destroy wheat in Reno, working on rye in Republic, but occasioning no apprehension in Cherokee county. June 1, 1882, p. 340. *Clay, Johnson, Jewell, Labette, and Riley Co's.* Chinch bugs plenty. *Dickinson, Doniphan, and Wilson Co's.* Wheat being damaged. June 8, 1882, pp. 353, 360. *Bourbon, Harvey, Lyon, Morris, Rush, Saline, and Smith Co's.* Wheat more or less injured by chinch bugs. *Elk Co.* No young bugs yet; plenty of old ones. *Labette Co.* Chinch bugs plenty; no damage yet. June 15, 1882, p. 372. *Butler Co.* Chinch bugs numerous. June 22, 1882, p. 388. *Butler, Leavenworth, and Phillips Co's.* Chinch bugs numerous. June 29, 1882, p. 409. *Montgomery Co.* More chinch bugs wintered last season than ever before, but wet weather, occurring about the time for depositing eggs, kept them back. July 20, 1882, p. 36. *Ellsworth Co.* Chinch bugs present, but doing no damage. Aug. 3, 1882, p. 68. *Clay Co.* Some chinch bugs, but doing no damage.

MINNESOTA.—May 18, 1882, p. 308. *Isanti Co.* Fear chinch bugs will damage wheat. June 15, 1882, p. 377. *Mower Co.* "Our farmers have been suffering with chinch-bug wheat crops for the last four years, but last year we put in a great breadth of corn and more oats than usual." June 22, 1882, p. 388. *Scott, Wabasha, and Washington Co's.* Chinch bugs reported. June 22, 1882, p. 404. *Dodge Co.* Chinch bugs alarming. *Fillmore, Goodhue, Olmsted, and Winona Co's.* Chinch bugs present. July 13, 1882, p. 20. *Fillmore and Isanti Co's.* Chinch bugs reported. July 20, 1882, p. 36. *Goodhue, Houston, Washington, Isanti, and Le Sueur Co's.* Chinch bugs present. July 26, 1882, p. 52. *Olmsted and Ramsey Co's.* Chinch bugs reported. Aug. 3, 1882, p. 68. *Dakota and Fillmore Co's.* In spring wheat. Aug. 10, 1882, p. 84. *Carver and Isanti Co's.* In spring wheat. Aug. 17, 1882. *Dakota Co.* Spring wheat is being injured in some places. Aug. 24, 1882, p. 116. *Dakota and Goodhue Co's.* Chinch bugs very bad in spring wheat.

MISSOURI.—Apr. 13, 1882, p. 228. *Boone and La Fayette Co's.* Chinch bugs plenty. *St. Francis Co.* Chinch bugs still alive. Wheat never better. Apr. 20, 1882, p. 244. *Audrain Co.* Some chinch bugs. Apr. 27, 1882, p. 260. *Boone, Bates, Carroll, and Newton Co's.* Chinch bugs more or less numerous. *Polk Co.* (17). "Myriads of chinch bugs were seen in the timber previous to last

rain, which has greatly diminished their number." May 4, 1882, p. 276. *Howard, Lawrence, Lewis, Livingston, and Nodaway Co's.* Chinch bugs reported as more or less numerous; but wheat "splendid" in Howard Co. May 11, 1882, p. 292. *Audrain, Barton, Bates, Bollinger, Caldwell, Cass, Cooper, Green, La Fayette, McDonald, Miller, Moniteau, and Pettis Co's.* Chinch bugs more or less numerous. Injuries not mentioned. In Caldwell county said to be doing no harm. May 18, 1882, p. 308. *Dade, Henry, Lewis, Shelby, and St. Genevieve Co's.* Chinch bugs numerous. *Calloway, Lawrence, Lincoln, and Ray Co's.* Wheat being seriously damaged. *Jasper Co.* Cold rains have destroyed chinch bugs. May 25, 1882, p. 324. *Boone, Cass, Carroll, Chariton, Monroe, Pike, and St. Charles Co's.* Chinch bugs numerous. *Benton Co.* Oats gone, corn attacked. June 1, 1882, p. 340. *Bates, Boone, Cape Girardeau, Christian, Greene, Lawrence, Livingston, and Saline Co's.* Chinch bugs numerous, but no damage reported. June 8, 1882, p. 353. *Bates, Dade, and Livingston Co's.* Winter wheat some damaged. *Benton Co.* Oats nearly destroyed. *Saline Co.* Chinch bugs plenty. June 22, 1882, pp. 388, 393. *Pettis Co.* Chinch bugs plenty. *Polk Co.* (17). Chinch bugs reduced by wet weather. June 29, 1882, p. 409. *Ralls Co.* Chinch bugs reported, but doing no harm.

NEBRASKA.—April 20, 1882, p. 244. Chinch bugs alive and active. June 15, 1882, p. 372. *Seward Co.* Chinch bugs working on tame grass. *Washington Co.* Some chinch bugs. June 22, 1882, p. 388. *Seward Co.* Chinch bugs working on tame grass. June 29, 1882, p. 404. *Jefferson Co.* Spring wheat infested. *Platte Co.* Chinch bugs plenty, but no damage. July 6, 1882. *Buffalo, Clay, Fillmore, Gage, Hall, and Merrick Co's.* Chinch bugs reported. July 13, 1882, p. 20. *Furnas, Hamilton, Thayer, and Webster Co's.* Chinch bugs more or less numerous, but no damage reported. July 20, 1882, p. 36. *Platte Co.* Some chinch bugs. Aug. 3, 1882, p. 68. *Cass Co.* Wheat full of bugs. Aug. 10, 1882, p. 84. *Harlan Co.* Spring wheat likely to suffer badly. Aug. 17, 1882. *Merrick Co.* Spring wheat slightly injured.

OHIO.—May 18, 1882, p. 308. *Putnam Co.* Some chinch bugs in wheat. *Scioto Co.* Chinch bugs plenty. June 1, 1882, p. 340. Cold weather killed the chinch bugs.

WISCONSIN.—June 15, 1882, p. 372. *Eau Claire Co.* Chinch bugs plenty. June 29, 1882, p. 404. *La Crosse and Waukesha Co's.* Complaint of chinch bugs. In spring wheat in the latter county. July 6, 1882, p. 420. *Grant Co.* Spring wheat full of chinch bugs. *La Fayette Co.* A few chinch bugs. July 6, 1882, p. 425. *La Fayette Co.* Chinch bugs numerous, but no damage yet reported. July 13, 1882, p. 20. *Grant and La Crosse Co's.* Chinch bugs numerous. July 20, 1882, p. 36. *Vernon Co.* Some chinch bugs. July 27, 1882, p. 52. *Pepin Co.* Some chinch bugs. Aug. 10, 1882, p. 84. *Vernon Co.* Thick in spring wheat. Aug. 17, 1882. *Kenosha Co.* Some chinch bugs in spring wheat. Aug. 24, 1882, p. 116. *Chippewa and Eau Claire Co's.* Chinch bugs doing much damage to spring wheat.

ILLINOIS CROP PROSPECTS. Consolidation of Reports returned to the Department of Agriculture April 1, 1882. Circular No. 84, pp. 3, 21-27.

Imminent danger from chinch bugs in various parts of State, especially where drouth prevailed in 1881. Millions seen flying at this early date.

Correspondents' Remarks. *Bond Co.* Millions of chinch bugs flying April 2. *Carroll Co.* Injured rye in many localities last fall. *Crawford Co.* Present in numbers. *Edgar Co.* Unusually numerous in weeds near wheat fields. *Franklin, Hamilton, Monroe, Union, White,* and *Williamson Co's.* Present in large numbers. *Logan Co.* Unusually numerous in hedges and fence rows. *Montgomery Co.* Have appeared.

FARMERS' REVIEW, Apr. 20, 1882, v. 8, p. 249.

Editor says: "Should we have a dry season, from information now in our possession, we fear that they [chinch bugs] will in Missouri, Kansas, and Illinois do damage."

ILLINOIS CROP PROSPECTS. Consolidation of Reports returned to the Department of Agriculture May 1, 1882. Circular No. 86, pp. 3, 4, 29-44, 45.

Many chinch bugs in winter wheat in various localities, but no serious damage yet owing largely to frequency of cold rains. Most damage in fields next to timber, the leaves affording shelter to the bugs. The number of chinch bugs and army worms in central and southern counties should prepare the public for a large reduction of wheat crop. The chinch bug has come through the past exceptionally wet winter without much apparent diminution in numbers, and is reported in many parts of the State.

Correspondents' Remarks.—*Alexander, Calhoun,* and *Jefferson Co's.* Some chinch bugs in sheltered places. Little or no damage yet. *Bond, Cass, Clark, Clinton, Coles, Hardin, Jefferson, Johnson, Lawrence, Madison, Menard, Randolph, Saline, Wayne, White,* and *Williamson Co's.* Present in considerable or large numbers, but little or no damage yet. *Crawford* and *Pope Co's.* Causing considerable damage to wheat. *Cumberland, Hancock,* and *Richland Co's.* At work on wheat, but little or no damage yet. *Edwards Co.* Wheat adjoining timber is being damaged by the bugs. *Hamilton Co.* Wheat injured in localities. *Jackson Co.* Appeared earlier than usual. Much apprehension. *Jersey, Sangamon, Schuyler,* and *Shelby Co's.* Kept in check by rains. *St. Clair* and *Wabash Co's.* Have done some injury. *Union Co.* A few seen.

FARMERS' REVIEW, May 4, 1882, v. 8, p. 282, Chinch Bugs in April.

Apr. 26, correspondent observed young bugs on timothy hay from stack. Eggs supposed to have been laid on timothy stems the year before [?].

INDIANA FARMER, May 20, 1882, v. 17, p. 4. Winter Wheat in Illinois.

Chinch bugs in large numbers are reported in various localities.

ILLINOIS CROP PROSPECTS. Consolidation of Reports returned to the Department of Agriculture June 1, 1882. Circular No. 88, pp. 3, 33-56, 60.

Chinch bugs, though very numerous, have not injured the grain crops, owing to the cold wet season. "Old chinch bugs are depositing their eggs in corn and wheat, and with continued warm and seasonable weather there will be a large number of young bugs ready for the corn."

Correspondents' Remarks.—*Alexander and Pope Co's.* Corn damaged or threatened. *Bond, Calhoun, DeWitt, Douglas, Edgar, Hamilton, Jersey, La Salle, Macoupin, Pike, and Saline Co's.* More or less numerous, but little or no injury reported. *Clark, Cumberland, McDonough, Menard, Rock Island, Scott, and White Co's.* Present in force but held in check by rains. *Clinton, Crawford, Hardin, Lawrence, Logan, Madison, Stark, and St. Clair Co's.* Winter or spring wheat more or less injured. *Edwards Co.* Laying eggs on corn. Have damaged wheat in vicinity of timber belts. *Johnson Co.* Have not done much damage to corn, but have injured winter wheat. *Macon Co.* Chinch bugs plenty and depositing eggs, which, however, are not likely to hatch till wheat is out of danger. *Monroe Co.* Corn much injured by chinch bugs, army worms, and grubs. *Piatt Co.* Corn near hedges and timber injured by chinch bugs, but cold weather has kept them in check.

FARMERS' REVIEW, June 8, 1882, v. 7, p. 353.

Cold, heavy, and continuous rains have, in a great measure, destroyed the new-laid eggs of the chinch bugs in Illinois. In Missouri winter wheat was threatened, but the danger was averted by rains. Chinch bugs have appeared and disappeared in Nebraska and Minnesota.

ILLINOIS CROP PROSPECTS. Consolidation of Reports returned to the Department of Agriculture July 1, 1882. Circular No. 90, pp. 32, 35, 38, 41.

Correspondents' Remarks. *Alexander, Henry, Jackson, Madison, and Randolph Co's.* Chinch bugs in corn; but little damage done as yet. Infesting oats also in Henry county. *Bureau and Randolph Co's.* Damaging spring wheat.

J[OHNSON], B. F.—[Letters from Champaign Co., Illinois, in Cultivator and Country Gentleman.]

July 6, 1882, v. 47, p. 530. Reports chinch bugs in corn, broom-corn, and sorghum June 27. Does not know that they have materially injured wheat and oats. July 13, 1882, p. 548. Mature bugs numerous in Champaign Co. July 4; the young, less so. July 20, 1882, p. 566. Chinch bugs in corn, broom-corn, and

sorghum. Young bugs have hatched within a week. Aug. 3, 1882, p. 602. Notwithstanding the previous rain and cool weather, chinch bugs are threatening corn and sorghum again, now that the weather is warm and dry. Aug. 17, 1882, p. 643. Broom-corn in *Champaign, Piatt, Douglas, and Coles Co's* injured by chinch bugs.

FARMERS' REVIEW, July 13, 1882, v. 9, p. 25. Iowa Crops.

"Seven counties report the air filled with chinch bugs. In some cases they have settled on the spring wheat fields, but no serious damage is done."

ILLINOIS CROP PROSPECTS. Consolidation of Reports returned to the Department of Agriculture August 1, 1882. Circular No. 92, pp. 52-63.

Correspondents' Remarks.—*Douglas, Johnson, Macoupin, Vermilion, Wabash, and Williamson Co's.* Corn suffering more or less from drouth and chinch bugs, and winter wheat injured in Macoupin county.

CULTIVATOR AND COUNTRY GENTLEMAN, Aug. 10, 1882, v. 47, p. 622. From Central Nebraska.

Lincoln, Neb., July 28. Wheat injured by rust and chinch bugs.

FORBES, S. A.—The Chinch Bug in 1882. Field Notes. (Illinois Crop Reports. Consolidation of Reports returned to the Department of Agriculture Aug. 1, 1882. Circular No. 92, p. 77; Western Rural, ———, 1882; Farmers' Review, Oct, 19, 1882; Review and extracts in Prairie Farmer for ———, 1882.)

Appeared at usual time in extraordinary numbers in Central Illinois, but rains delayed deposition of eggs and prevented many from hatching, so that young bugs were not seen until about the first of July. Owing to their late development small grain was not appreciably damaged, and corn and similar crops have been little injured because there has been no concentrated attack. The bugs are, however, much more numerous than the damage sustained indicates, and every precaution should be taken against a serious outbreak next season. Careful experiments seem to show that too much is hoped from the simple influence of wet weather upon these insects. Bugs on corn drenched ten successive days were not affected appreciably. Small brown ant, *Lasius flavus* [*alienus*], attends young, transporting them in its mouth, and feeding on exudations from the corn and on the fluids excreted by the bugs. *Agonoderus comma* preys upon them, chinch bugs making about twenty per cent. of food of specimens dissected. Internal bacterium parasite again mentioned. Burning in winter quarters advised. A weak emulsion of kerosene and soap suds, costing three fourths of a cent a gallon, killed chinch bugs very readily. "Advantage can probably be taken of this fact to save many fields of corn which would otherwise be destroyed by them."

FARMERS' REVIEW, Aug. 24, 1882, v. 9, p. 113.

Notice of experiments by Prof. S. A. Forbes with an insecticide mixture for the chinch bug; viz., an emulsion of water, kerosene, and milk, costing half a cent a gallon, and applied with a simple machine.

FARMERS' REVIEW, Aug. 31, 1882. Warsaw Horticultural Society.

Chinch bugs quite numerous in some corn fields.

FORBES, S. A.—Bacterium a Parasite of the Chinch Bug. (American Naturalist, Oct., 1882, v. 16, p. 224. Abstract of article, with extracts, in Prairie Farmer for ———, 1882.)

Chinch bugs under observation died rapidly and unaccountably. Microscopical examination of the fluids from the crushed bodies of both living and dead bugs showed them to be swarming with a species of bacterium, having its principal, perhaps exclusive, seat in the alimentary canal. Bugs in the field diminished rapidly, the mortality being, however, chiefly among the older insects.

POPENOE, E. A.—The Chinch Bug and the Season. (Prairie Farmer, Nov. 25, 1882.)

Chinch bug everywhere abundant in Kansas in early spring months, some badly infested fields being turned under by the plow, and young corn near wheat or meadow-lands being destroyed by invading chinch bugs. Abundance of rain following, season proved on the whole unusually free from damage. Possible that simple excess of moisture drowns young bugs on the ground, but doubts if others are so affected. Gives illustrations of tenacity of life in chinch bugs. Recalls Dr. Shimer's theory of epidemic disease, cites Thomas's opinions in support of it, and quotes experiments made by Forbes in which chinch bugs were artificially drenched for many successive days without effect. Also refers to Forbes's observations on bacterial parasite of chinch bug. Reports recently finding in Southeastern Kansas situations where chinch bugs died in great numbers in corn fields, "each dead bug being covered with a strong growth of white mold." Connects this occurrence with Shimer's and Forbes's statements. Cites Forbes's experiments with kerosene emulsion for chinch bug.

J[OHNSON], B. F.—Notes from Champaign, Ill. (Prairie Farmer, Dec. 9, 1882.)

By destroying volunteer wheat great numbers of the Hessian fly and chinch bug would be destroyed.

FORBES, S. A.—Another Chinch-Bug Parasite. (Prairie Farmer, Dec. 9, 1882.)

Referring to Popenoe's article of Nov. 25, surmises that white mold mentioned is identical with a fungus found destroying chinch bug in corn fields near Jacksonville in September. This fungus, identified by Prof. Burrill as an Entomophthora, imbedded the chinch bugs and fastened them to leaves and stalks of corn. Re-

ports successful cultivation, in beef broth, of bacterium parasite of the chinch bug, lately described by Burrill as *Micrococcus insectorum*; but opportunity failing for experiments upon insects with artificial cultures, conclusive proof is wanting that this *Micrococcus* is destructive to chinch bugs. Writer believes from personal observations and evidence of correspondents that first brood of chinch bugs was either destroyed by rains and cold, or so hindered in deposition of its eggs that only one brood was generally developed in Central and Northern Illinois. Considers it unlikely that chinch bugs will appear in destructive numbers in this State next year. Can find but small number hibernating.

BOARDMAN, E. R.—Economic Entomology. The Chinch Bug. (Stark County [Ill.] News, Dec. 14, 1882.)

General article discussing history, life history, name, remedies, etc.

PARKER, CHARLES.—How to beat the Chinch Bugs. (Farmers' Review, Dec. 28, 1882.)

Claims that soaking spring seed wheat in brine for two weeks—drying off before sowing—will render the grain so much earlier and more vigorous that chinch bugs will not injure it.

ILLINOIS CROPS FOR 1882. Circular No. 94 [of the Department of Agriculture], p. 84.

The drouth and chinch bugs reduced the yield of corn in some localities in Madison county.

HOWARD, L. O.—White Blast. (Report of the Entomologist of the [U. S.] Department of Agriculture, 1882, p. 137.)

"The common chinch bug (*Blissus leucopterus*) was also found upon the blasted heads [of rice] in several cases" [in Georgia].

RILEY, C. V.—Chinch-Bug Notes. Predictions in Relation to Injury. (Report of the Entomologist of the [U. S.] Department of Agriculture, 1882, pp. 86, 89.)

Mention of Thomas's studies and predictions and the injuries of 1881; of appearance of the pest in 1882, and probable checking by rains; and of remedies and preventive measures,—irrigation, burning of the hibernating bugs, early sowing of spring wheat, and clean culture being especially emphasized, and the use of the kerosene emulsion advocated.

THOMAS, CYRUS.—Best Means of counteracting Insect Foes. (Trans. Ill. State Hort. Soc., 1881, v. 15, n. s., pp. 39-46.)

Recalls previous predictions, based on rainfall record, that chinch bug should be expected in 1880 and 1881 if those years be dry, and advice to farmers to rely on oats rather than corn for the latter year. Remarks on fulfillment of prediction and loss of farmers because of failure to follow recommendation. Considers it sheer folly to talk of protecting crops by topical applications.

Believes that entomological prediction based on meteorological records promises the most important aid. Thinks that such records are sufficient to give a forecast of the coming year with reference to rainfall with reasonable certainty, at least in the Northwest, and that farm crops may consequently be selected to avoid injury by insects most likely to appear. Prediction that "chinch bug will not be injurious next year (1882) in the Northwest, (1) because year will not be dry; (2) because these insects have not been known to appear generally and in great numbers for two successive seasons; and (3) because the recent rains have to a great extent destroyed them." Mentions as remedies especially applicable to chinch bug, irrigation, burning in winter quarters, and cropping against them. Advises Central and Southern Illinois farmers "to cease raising so much corn and to rely to a greater extent upon oats, grass, and other crops." Says that corn, spring wheat, and barley are the crops that chiefly assist in developing these insects. Early crops least likely to suffer. Early varieties of oats and corn should be selected when chinch bug is apprehended. In discussion following (pp. 48, 49), reported as saying that "if we ever get rid of this pest we must quit raising corn." In Kansas they are legislating to prevent the raising of winter wheat as one means of reducing this insect. "If we abandon the growing of winter wheat and corn they must perish."

JOHNSON, J. S.—[Chinch-Bug Notes.] (Trans. Ill. State Hort. Soc., 1881, v. 15, p. 49.)

Reported as saying that chinch bugs were plenty in 1848 near Nauvoo, where he lived, and that in 1849 they took the corn. Found in myriads in the grass the fall succeeding. Has held them in water more than an hour without injury to them. Took corn this year, a mile away from any wheat.

PRAIRIE FARMER, ——. 1882. [Destroying Insects.]

"When chinch bugs are prevalent in corn the stalks should be raked together and burned, and all dead grass-bottom should be served in the same way."

THOMAS, CYRUS.—Best Means of counteracting our Insect Foes. (Trans. Ind. Hort. Soc., 1881, p. 81.)

Prophecy that the chinch bug would do little damage in 1882.

TREAT, MARY.—The Chinch Bug. (Injurious Insects of the Farm and Garden, pp. 112-120.)

Feeds on grasses and cereals. Short-winged form in Canada and more northern states. Hibernates as an adult. Two-brooded in Middle States; probably three broods in more southern states. Eggs deposited under ground on roots of food plants; the more compact the soil, therefore, the less this operation is facilitated, and hence the advantage of fall plowing for spring grain, or of repeated rolling after seeding if plowing is done in spring. Wet land, heavy rains, and open winters prejudicial to it. Instances

given of the prodigious numbers and ravages of the chinch bug, with successful method of fighting it—tarred boards, with deep holes every ten feet just outside. The false chinch bug and the ash-gray leaf-bug sometimes mistaken for the chinch bug. Illustrations. Two hemipterous insects, larvæ of lady bugs, and ants, are mentioned as natural enemies, the latter (which destroy the eggs) being regarded as the most efficient. As remedies, burning rubbish and badly infested crops is recommended; also the sowing of winter rye with spring wheat—one bushel of rye to twelve of wheat.

REPORT OF ENTOMOLOGIST OF THE [U. S.] DEPARTMENT OF AGRICULTURE, 1882, pp. 64, 65. Extracts from Correspondence.

Serious injuries reported from Austin, Mo., and Marion county, Ill.

1883.

FORBES, S. A.—A Lecture on Insects affecting Corn, pp. 17–20. (Read before a Farmers' Institute at the State Industrial University, Champaign, Illinois, Jan. 29, 1883, and issued in pamphlet form the same year. Review in *Advance Farmer*, July, 1883.)

Brief mention of life history, remedies, and natural enemies, bacterial and fungus parasites being especially noted.

RILEY, C. V.—Entomological Notes. Diseases of the Chinch Bug. (*Rural New Yorker*, Feb. 17, 1883.)

Brief reference to the bacterial and fungus enemies of the chinch bug found by Professors Forbes and Popenoe.

FORBES, S. A.—Insects affecting Corn. (*Prairie Farmer*, Feb. 23, 1883.)

"When the chinch bug and army worm are in adversity we considerately and generously cease from troubling them, arousing ourselves to attack them only when they are strong and triumphant. Perhaps this is not the best way. We may find them more vulnerable when they are weak and few, if we take the trouble to study them at that time."

BEEDY AICH [HALSTED, B. D.]—The Chinch Bug. (*Farmers' Review*, March 22, 1883.)

Compiled general article, mentioning Riley's estimate of loss by chinch bug in 1874 in Illinois and Missouri as fifty million dollars, giving number of broods, place of depositing eggs, effect of weather, and remedies.

COLMAN'S RURAL WORLD, April 19, 1883. Salt on Wheat.

Notice of a previously printed statement that salt will drive chinch bugs out of wheat and corn fields, and as confirmatory the following item is quoted: "The Massachusetts Agricultural So-

ciety concludes that salt as a manure has the property of hastening the maturing of all crops; that wheat on salted land will ripen six to ten days earlier than on unsalted land, all other conditions being equal; and that it increases the yield from twenty-five to fifty per cent."

FARMERS' REVIEW. FARMERS' REVIEW OF THE SEASON.

May 10, 1883, p. 296. *Coles, Putnam, and Schuyler Co's.* Some complaint of chinch bug. May 17, 1883, p. 312. *Fayette Co.* A few chinch bugs. May 24, 1883, p. 328. *Schuyler Co.* Complaint of chinch bug. *Williamson Co.* Chinch bugs by the million.

KANSAS.—May 24, 1883, p. 328. *Wilson Co.* Chinch bugs present.

MISSOURI.—May 10, 1883, p. 296. *Bates and St. Genevieve Co's.* Complaint of chinch bugs.

NEBRASKA.—May 10, 1883, p. 296. *Saline Co.* Chinch bugs doing injury.

FORBES, S. A.—Experiments on Chinch Bugs. (U. S. Dept. Agr., Div. Ent., Bull. No. 2, pp. 23-25. Republished in *Western Rural*, June 23, 1883, and *Rural New Yorker*, Aug. 11, 1883. Abstract in *Cultivator and Country Gentleman*, May 10, 1883, and in *American Naturalist*, v. 17, p. 862.)

Memoranda of eleven experiments made in July and August with kerosene emulsion in milk and soap suds, variously diluted, and applied to chinch bugs on corn. Dilutions used ranged from three to five per cent. of kerosene. As a rule, the stronger mixtures killed about four fifths of the bugs upon a single application, and this without damage to the corn.

PRAIRIE FARMER, May 12, 1883; FARMERS' REVIEW, Aug. 9, 1883, p. 83.

A Kansas farmer quoted as finding one hundred chinch bugs, with other insects, in stomach of quail shot in corn field.

ILLINOIS CROP PROSPECTS. Consolidation of Reports returned to the Department of Agriculture June 1, 1883. Circular No. 100, pp. 42, 52. Correspondents' Remarks.

Crawford Co. Much complaint of chinch bugs. *Madison Co.* At work on wheat.

WESTERN RURAL, June 16, 1883.

Correspondent from Davis Co. [Davis, Indiana Co.?] Penn., writes: "Oats and grass look well, but we do not know what effect the chinch bugs will have on them, for they are here in abundance."

ILLINOIS CROP PROSPECTS. Consolidation of Reports returned to the Department of Agriculture July 1, 1883. Circular No. 102, pp. 28, 35. Correspondents' Remarks.

Clinton Co. Corn prospects injured in some localities. *Madison Co.* Wheat yield reduced by Hessian fly and chinch bug.

ILLINOIS CROP PROSPECTS. Consolidation of Reports returned to the Department of Agriculture August 1, 1883. Circular No. 104, pp. 60, 63. Correspondents' Remarks.

Perry Co. Chinch bugs doing but little damage. *Washington Co.* Working on corn locally.

FORBES, S. A.—[Memoranda with regard to the Contagious Diseases of Insects and the possibility of using the virus of the same for economic purposes.] (Abstracts more or less full, in *St. Paul and Minneapolis Pioneer Press*, Aug. 16, 1883; *Minnesota Tribune* of same date; *Canadian Entomologist*, Sept., 1883; and in *American Naturalist*, Nov., 1883, v. 17, p. 1170.)

Occurrence of bacterial disease of chinch bug reported, and compared with *flacherie* or *schlaffsucht* of silkworm. Apparently caused by a microbe abundantly developed in the alimentary canal. Bugs disappeared rapidly in the field where this disease was recognized, the mortality being chiefly among adults. Disease developed rapidly in chinch bugs kept in confinement without food. Bacteria seemed identical with those found in gummy substance under sheaths of corn leaves. Cultivated readily in organic infusions.

LINTNER, J. A.—The Chinch Bug must go. (*Albany Argus*, Oct. 10, 1883. Reprinted in part, with editorial comment, in *Cultivator and Country Gentleman*, Oct. 18, 1883.)

In Northern New York its work was first discovered in June, 1882, when a few acres of timothy were badly damaged. In June, 1883, other fields were infested. Mention of pecuniary losses in Illinois and the United States generally, from ravages of this insect, and also of migratory habit. Brief description given and observations upon the recent attack in New York, of which the range is about eight miles. Invasion threatens to be serious, as, contrary to precedent, the insect has thriven far to the north on one of its most unusual food plants, and multiplied, contrary to all rule, in face of the excessive rains of the past two seasons. Prompt, earnest, and combined effort against the pest urged,—deep fall plowing; burning, when condition of grass will permit; heavy rolling of infested fields in spring, also of wheat fields just as they are liable to attack; and use of kerosene emulsion as soon as attack is discoverable.

ALBANY [N. Y.] ARGUS, Oct. 10, 1883. A New Enemy to the Farm.

General editorial calling attention to Dr. Lintner's article, abstracted above, on appearance of the chinch bug in New York.

LINTNER, J. A.—The Chinch Bug in New York. (*Science*, Oct. 19, 1883, v. 2, p. 540. Article noted in *Rural New Yorker*, Nov. 17, 1883.)

Chinch bugs in northern New York in myriads. First appearance last year, in timothy. The attack is serious, and great alarm is felt. It continues to increase notwithstanding wet weather of last year and this. Kerosene emulsion recommended.

LINTNER, J. A.—Directions for arresting the Chinch-Bug Invasion of Northern New York. (Circular No. 1—October, 1883—New York State Museum of Natural History, Department of Entomology; Bull. No. 66 N. Y. Agricultural Experiment Station, Oct. 27, 1883. Reprinted, entire, in *American Rural Home*, Nov. 17, 1883, and in 2d Annual Rept. State Entomologist of N. Y., 1885, p. 161; and in part in *Cultivator and Country Gentleman*, Nov. 8, 1883.)

In portions of St. Lawrence county, New York, the chinch bug, though only "in the third year (probably) of its introduction and the second year of the observation of the attack," has spread to an alarming extent; but it seems practicable by combined effort at this stage to prevent its extension over the State. A close examination of meadows is urged, and three directions are given for immediate procedure; viz., burning dead grass, deep plowing of burned area, and harrowing and heavy rolling after plowing. Where meadows will not admit of plowing, gas lime may be distributed over the ground at the rate of two hundred bushels per acre. This may be postponed until November or the early spring, and should be confined to the infested portions of meadows unless distributed in February.

FORBES, S. A.—Entomological Notes of the Season. (*Illinois Crop Prospects*, Dept. Agriculture, Circular No. 106, p. 177; *Prairie Farmer*, Dec. 8, 1883, and March 22, 1884; *Chicago Evening Journal*, Mar. 14, 1884.)

The chinch bug was found in spring depositing the eggs for its first brood of young about the roots of corn—a habit not hitherto reported.

DIMMOCK, GEORGE.—Entomological Items. (*Psyche*, Nov.—Dec., 1883, v. 4, p. 119.)

On March 28 the low land between Belmont and Cambridge, Mass., was swarming with chinch bugs.

PRAIRIE FARMER, Dec. 1, 1883. Chinch Bugs, etc.

Report of interview with Prof. Forbes, who stated that about the only Illinois region in which the chinch bug had evinced any considerable activity this fall [1883] was in and about Champaign county. Reference to the appearance of the insect in New York, and republication of part of Lintner's Circular No. 1.

RILEY, C. V.—[The Chinch Bug in New York.] (Science, v. 2, p. 621. Reprinted in substance in Rural New Yorker, Dec. 15, 1883.)

Questions Lintner's conclusion that the injurious manifestation of the chinch bug in New York is due to an invasion. As the species has been found much farther north it seems more rational to suppose that it has only unduly increased where, though present, it had not heretofore been detected. The apparent lack of susceptibility to wet weather he attributes to the excessive multiplication of the insect during the very dry seasons of 1880 and 1881, and its ability, demonstrated in the West, to brave unfavorable weather for a time. This will tell, however, on the hibernating bugs.

ILLINOIS CROPS FOR 1883. Circular No. 106 [of the Department of Agriculture], pp. 140, 145. Correspondents' Remarks.

Johnson, Saline, and St. Clair Co's. Corn injured by drouth and chinch bugs.

COOKE, MATTHEW.—The Chinch Bug (*Micropus leucopterus*, Say). (Injurious Insects of the Orchard, Vineyard, Garden, etc., p. 280.)

General description, with figures. Trenching recommended as a remedial measure. Has not found a single specimen in California.

FORBES, S. A.—Studies on the Chinch Bug. (Twelfth Rept. State Ent. Ill., 1882, pp. 32-63; Brief summary of discussion in Bull. Ill. State Lab. Nat. Hist., v. 2, p. 258.)

Emphasizes the importance of "patient, thorough, and exhaustive research" before the contest with the chinch bug is abandoned as hopeless. Only a fairly complete life history for an average year during its periods of abundance has been made out, and some knowledge gained concerning its susceptibility to wet weather, although the exact way in which the bugs are affected by it is undetermined, repeated drenchings seeming to have no effect. 1882 an exceptional year. The season opened early, and old bugs appeared in threatening numbers, but prolonged and violent rains in May and June resulted in the almost complete destruction or suppression of the spring brood. The weather changing about July 1, eggs were laid in maize, broom-corn, and sorghum, most of them hatching by the middle of that month, matured specimens of this brood being first noted Aug. 8. The last of August a few young of a following brood [?] were seen at a single point in Southern Illinois—a local phenomenon. Flight of adults occurred from the middle of September to the middle of October. The bugs could not be found hibernating in or about fields where they had hatched. Concerning insect enemies of the species, the earliest references by Walsh and Shimer are noted, together with items by Webster, Thomas, and Riley; but the statement that ants destroy the eggs of chinch bugs lacks verification by dissection, and though one of them may occasionally be seen with a chinch bug in its mouth their "car-

nivorous intentions" are doubtful. All the lady bugs and their larvæ feed upon the chinch bug, as also a common ground beetle (*Agonoderus comma*), the larva of the lace-wing fly, and one of the robber-bugs (*Harpactor cinclus*). The ground beetle mentioned was found by dissection to have derived about one fifth of its food from chinch bugs, and about eight per cent. of the food of *Coccinellidæ* captured among them consisted of these insects. A few common birds feed upon chinch bugs occasionally, but do not search for them. More important than insect and bird enemies are certain obscure fungus parasites (one, *Micrococcus insectorum*, *Burrill*) which give rise to fatal epidemics. As the possibility of propagating such diseases artificially has been proven, much may be hoped from this class of enemies. Dr. J. L. LeConte is mentioned as having suggested this possibility in 1873. Dr. Shimer is credited with the first published account of disease among chinch bugs,—quotations being made from his paper describing it,—and Dr. Cyrus Thomas's remarks thereupon are given with observations of his own upon epidemics among house flies and grasshoppers. Personal observations and studies on this subject began Aug. 3, 1882, and a series of careful experiments was instituted on the 5th. From the fact that these fungus parasites were found to be extremely abundant in the fluids of specimens from a field where the bugs were rapidly dying, and relatively few in adjacent fields, they were apparently related to the destruction, this view being confirmed by the fact that they were more abundant in old bugs than in young ones, while the mortality referred to was greatest among the former. It was found easy to cultivate the bacterium artificially, and an article by Metschnikoff is translated and quoted as bearing upon the probability of rearing this parasite successfully. No opportunity was afforded to apply the artificial infection to healthy insects. Some evidence is adduced of the possibility of artificially cultivating another parasite observed, belonging to the genus *Entomophthora*; and there is reason for believing that this was the active agent in the chinch-bug epidemic of 1865, reported by Dr. Shimer. Under the head of topical applications an article by Dr. Riley is quoted, giving the method of preparing kerosene emulsions; and experiments with emulsions of different strengths variously diluted and applied to infested hills of corn in the laboratory and in the field are described, the general result, as stated, being "that a simple mechanical mixture of water and three per cent. of kerosene is deadly to bugs of all ages and does not injure half-grown corn if the fluid is kept well shaken up. Data as to cost of mixture, quantity required, and mode of application are given, and it is suggested that possibly such preparations might be made useful in fields of small grain.

FORBES, S. A.—The Regulative Action of Birds upon Insect Oscillations. (Bull. Ill. State Lab. Nat. Hist., v. 1, No. 6, 1883, p. 9.)

A few chinch bugs were found in the food of the house wren.

FORBES, S. A.—The Food Relations of the Carabidæ and Coccinellidæ. (Bull. Ill. State Lab. Nat. Hist., v. 1, No. 6, pp. 43, 53.)

Chinch bugs found in the food of specimens of *Agonoderus*, and in that of *Hippodamia convergens* and *H. glacialis*.

PACKARD, A. S.—[The Chinch Bug.] (Guide to the Study of Insects, p. 543.)

General description given and habits briefly noted. Ranges from Kansas and Nebraska to the Atlantic Coast. Has taken it in Maine and even on the summit of Mt. Washington. Quotes from Shimer and Walsh as to ravages in 1850 and 1864, and also from Shimer's account of the epidemic of 1865.

COQUILLETT, D. W.—Rapid Increase of Insects on Cultivated Lands. (Trans. Ill. St. Hort. Soc., 1882, p. 44.)

Beneficial results obtained in Northern Illinois by sowing wheat and oats together to prevent chinch-bug injury. Mention of sowing clover with wheat for same purpose.

1884.

RILEY, C. V.—[Chinch Bugs in New York.] (American Naturalist, Jan., 1884, v. 18, p. 79.)

Commenting on the appearance of chinch bugs in Northern New York, as reported by Prof. Lintner, sees no reason for considering the outbreak an invasion, but presumes it to be an unusual development of the species, due perhaps to successive drouths, the reacting wet weather of this year having not yet taken pronounced effect upon them. Predicts rapid decrease of the pest, and that they will probably perish in immense numbers the coming winter, but thinks, nevertheless, that the measures recommended by Lintner should be generally carried out.

FARMERS' REVIEW, Jan. 10, 1884. Where are the Insects during the Winter? [Editorial.]

"The chinch bug rests in winter in the mature state beneath dead grass, corn stalks, and rubbish generally. They may be destroyed by burning over the infested fields."

ILLINOIS CROP PROSPECTS. Consolidation of Reports returned to the Department of Agriculture Apr. 1, 1884. Circular No. 108, p. 21. Correspondents' Remarks.

Richland Co. If weather continues warm, chinch bugs will fly early and seriously damage wheat that was not winter-killed.

ILLINOIS CROP PROSPECTS. Consolidation of Reports returned to the Department of Agriculture May, 1, 1884. Circular No. 110, p. 34. Correspondents' Remarks.

Logan Co. Seed wheat soaked in strong salt brine has been sown, and it is believed that such a preparation of spring wheat will cause it to mature early and ripen before damage by chinch bugs.

WESTERN RURAL, May 17, 1884. Insecticides.

Editorial mention of Professor Forbes's success in destroying chinch bugs with kerosene emulsion.

KANE, KIRK.—How to beat the Chinch Bugs. (Prairie Farmer, June 21, 1884. Extract in The Issue, July 5, 1884.)

Writing from Southern Illinois notes general immunity from chinch-bug damage in 1874 and 1882 in wheat fields where timothy had been sown the fall before, while others were destroyed. Thinks the thick growth of timothy holds dampness nearly all day and prevents the increase of the bugs.

ILLINOIS CROP PROSPECTS. Consolidation of Reports returned to the Department of Agriculture Aug. 1, 1884. Circular No. 116, p. 61. Correspondents' Remarks.

Hamilton Co. Chinch bugs have made their appearance again in localities.

FORBES, S. A.—Notes of the Year [1883]. (Thirteenth Rept. State Ent. Ill., p. 9. Abstract in Cultivator and Country Gentleman; Oct. 30, 1884.)

Practically no damage by the chinch bug in 1883, but it is not far below the danger line.

HARRINGTON, W. H.—Exhibition of Insects. (Can. Ent. Nov., 1884, v. 16, p. 218.)

Exhibited specimens of chinch bugs from Sydney, Cape Breton, where he had found them abundant.

ILLINOIS CROPS FOR 1884. Circular [of the Department of Agriculture], No. 118, pp. 160, 166. Correspondents' Remarks.

Clark Co. Corn, in localities, poor and chaffy, owing to chinch bug and drouth. Marion Co. Yield of corn far short of that of 1883, owing to the chinch bug.

BRUNER, LAWRENCE.—Notes from Nebraska. (Rept. [U. S.] Commiss. Agric., 1884, p. 399.)

Great numbers of bugs appeared in grain fields in Cuming, Burt, and Washington counties early in July, but heavy rains set in soon after and the bugs disappeared.

FORBES, S. A.—The False Chinch Bug (*Nysius destructor*, Riley). (Thirteenth Rept. State Ent. Ill. [1883], p. 105.)

Distinction between chinch bug and false chinch bug noted.

MENDENHALL, R. J.—Entomological Notes for the Season of 1883. (Trans. Minn. State Hort. Soc., 1884, p. 140.)

Chinch bug presumed to have done considerable damage in Minnesota, locally, in 1883. Habits of the insect noted, and the standard remedies. Farmers said to sow Hungarian grass or millet with their small grain to divert the bugs from the latter; or fields are bordered with these forage crops, corn sometimes being

saved by a belt of sorghum. Clover is also sowed with wheat, it being claimed that the clover keeps the surface of the soil too cool to suit the habits of the bug. Main reliance, the occurrence of heavy rains in the fall and late in spring. Notice of the bacterial diseases of the insect as discussed by Prof. Forbes in paper read before the Biological Section of the A. A. A. S. in 1883.

RILEY, C. V.—Chinch-Bug Notes. (Rept. [U. S.] Commiss. Agric., 1884, pp. 403-495.)

Mentions the outbreak in New York and reprints some of the literature of the subject, giving Dr. Lintner's apprehensions and predictions and dissenting therefrom, and adding testimony confirming his own views.

1885.

FARMERS' REVIEW, May 21, 1885.

The chinch bug is reported at work in wheat in districts where present last fall.

FARMERS' REVIEW. CROP REPORTS.

June 18, 1885. *Clinton Co.* Chinch bugs abundant. *Jefferson Co.* Common. *Jasper and Randolph Co's.* Winter wheat injured. July 1, 1885. *Bond, Clay, and Effingham Co's.* Wheat injured. July 8, 1885. *Washington Co.* Chinch bugs in some localities. July 15, 1885. *Shelby Co.* Thick on wheat. *Wayne Co.* Leaving wheat and going to corn. July 29, 1885. *Greene Co.* Chinch bugs appearing. Wheat all cut. *Wayne and Washington Co's.* Wheat damaged. Aug. 26, 1885. *Madison Co.* Corn injured by drouth and chinch bugs. Sept. 8, 1885. *Franklin Co.* Injuring corn. Sept. 30, 1885, *Bond, Clark, Clinton, Fayette, Hamilton, Jefferson, Madison, Marion, Richland, Wayne, and Williamson Co's.* Corn more or less damaged by chinch bugs and drouth,—the latter mentioned for six of the above counties, but chinch bugs and wet weather for Richland county. Oct 7, 1885. *Clinton Co.* Corn full of chinch bugs. Nov. 18, 1885. *Jasper Co.* Corn somewhat damaged. Dec. 16, 1885. *Edwards Co.* Much local injury by chinch bugs.

KANSAS.—May 28, 1885. *Ellis Co.* Chinch bug and Hessian fly injuring winter wheat.

STATISTICAL REPORT OF THE ILLINOIS STATE BOARD OF AGRICULTURE FOR JUNE, 1885. Circular 123, p. 33. Correspondents' Remarks.

Pope Co. Some complaint of injury to corn.

STATISTICAL REPORT OF THE ILLINOIS STATE BOARD OF AGRICULTURE FOR JULY, 1885. Circular 124, pp. 15, 19. Correspondents' Remarks.

Crawford and Madison Co's. Some complaint of chinch bugs.

STATISTICAL REPORT OF THE ILLINOIS STATE BOARD OF AGRICULTURE FOR AUGUST, 1885. Circular No. 125, pp. 14, 16, 17, 19, 21, 22, 23. Correspondents' Remarks.

Clinton, Jefferson, Macoupin, Madison, Pike, Richland, and Wayne Co's. Corn more or less damaged. *Effingham Co.* Numerous, but no injury to corn because of rains. *White Co.* Some complaint of chinch bugs.

PRAIRIE FARMER, Aug. 8, 1885. [Note on Crops.]

WISCONSIN.—*Monroe Co.* The chinch bug is finishing the destruction which the cold backward spring and dry summer began.

COOK, A. J.—Economic Entomology. [Abstract of address before the Am. Pomological Soc., at Grand Rapids, Mich.] (Prairie Farmer, Sept. 26, 1885.)

"Illinois has lost in one year \$75,000,000 worth of corn because of chinch bugs."

WEED, C. M.—Rise and Fall of the Chinch Bug. (Prairie Farmer, Oct. 31, 1885.)

Replying to query of a subscriber from Caldwell county, Mo., who writes that chinch bugs have disappeared in his locality, the influence of wet and dry weather upon this insect is discussed, diseases treated of by Shimer, Burrill, and Forbes are mentioned, and an extract from Shimer's article given. *Micrococcus insectorum* illustrated. Bugs said to be injurious in Effingham county, Ill., and mention made of prediction by Forbes that an outbreak may occur. A few collected in Champaign Co., Ill.

STATISTICAL REPORT OF THE ILLINOIS STATE BOARD OF AGRICULTURE FOR DECEMBER, 1885. Circular No. 126, pp. 23, 24, 26, 31, 33. Correspondents' Remarks.

Edwards, Effingham, Fayette, Hamilton, Kankakee, Richland, and Wayne Co's. Corn injured to some extent,—either as to quality or quantity.

FORBES, S. A.—Entomological Calendar. (Fourteenth Rept. State Ent. of Ill. (1884), p. 4.)

Contribution to the life history of the chinch bug. The usual existence of two broods inferred, with an occasional third. Life history essentially the same whether a year of great abundance or of scarcity.

LINTNER, J. A.—*Blissus leucopterus* (Say). The Chinch Bug. (Second Rept. on the Injurious and other Insects of the State of New York (1884), pp. 148-164. Figures.)

Gives short bibliography, account of the appearance of the insect in New York in 1882, description, history, origin of common name, (quoted from Fitch), and life history. As a general rule second brood less injurious than first, as their food plants are more advanced and better able to resist attack. A dimorphic.

short-winged form occurs in limited numbers in some localities. It is found in Canada, and at least twenty per cent. of the bugs obtained from the infested farm of Mr. King, in Northern New York, were of this form. Figures of wings and wing covers of each form are given. Statistics concerning injuries of the insect, and reprint of article in *Albany Argus*, Oct. 10, 1883 (previously abstracted), containing details of its operations in New York in 1882 and 1883. Additional observations upon this attack are given, and circular issued in Oct., 1883, giving directions for arresting ravages, is reprinted. These recommendations not being generally complied with, legislation compelling the desired action is advised. Apprehensions of increase and spread of the insect in 1884 not realized, the arrest of the attack being considered as mainly due to unfavorable meteorological conditions. A short list of other northern and eastern localities where the chinch bug has been observed is appended.

1886.

FARMERS' REVIEW. CROP REPORTS.

Apr. 14, 1886. *Bond* and *Richland Co's.* Wheat injured. May 26, 1886. *Hamilton* and *Richland Co's.* Wheat injured; much of that sown on corn land. June 2, 1886. *Bond*, *Edwards*, *Jefferson*, and *Monroe Co's.* Chinch bugs injuring wheat more or less. *Clark Co.* Indications of chinch bugs and army worms. June 9, 1886. *Christian*, *Greene*, and *St. Clair Co's.* Chinch bugs reported. June 16, 1886. *Crawford* and *Effingham Co's.* Chinch bugs in wheat. July 7, 1886. *Crawford* and *Madison Co's.* Damage to wheat and corn. *Wabash*, *Washington*, and *Wayne Co's.* Wheat damaged,—most of it in *Wayne*, and in *Washington* county oats also. July 14, 1886. *Bond Co.* Some corn damaged. Timely rain helped matters. *Jasper Co.* Corn badly damaged. *Marion Co.* Corn near wheat injured. *Perry Co.* Prairie wheat damaged. *Wabash Co.* Local injury to corn and wheat. *Richland Co.* Wheat all harvested; many bugs. July 21, 1886. *Bond* and *Jefferson Co's.* Wheat damaged. *Edwards Co.* Late corn damaged. *Madison Co.* Wheat, corn, and oats injured. Aug. 4, 1886. *Crawford Co.* Corn injured by drouth and bugs. *Richland Co.* Wheat damaged. *Wabash Co.* Corn damaged. *Washington Co.* Wheat injured by frost and bugs. Aug. 11, 1886. *Edwards* and *Rock Island Co's.* Corn being ruined by drouth and bugs. Aug. 25, 1886. *Clinton Co.* "Corn burnt, and eaten up by bugs."

KANSAS.—July 7, 1886. *Osage Co.* Some injury to wheat. *Franklin Co.* Wheat, oats, hay, and corn injured. *Sedgwick Co.* A good deal of corn killed.

[WEED, CLARENCE M.] —Insect Notes and News. (*Prairie Farmer*, May 8, 1886.)

Chinch bugs very numerous in portions of *Effingham* county.

[WEED, CLARENCE M.] —Insects affecting Hay Crops. (Prairie Farmer, May 29, 1886.)

Mention of chinch bug, with illustrations. "Just now it is doing serious injury in certain parts of Illinois."

STATISTICAL REPORT OF THE ILLINOIS STATE BOARD OF AGRICULTURE FOR MAY, 1886. Circular No. 128, pp. 13-25. Correspondents' Remarks.

Franklin, Perry, Richland, St. Clair, and Washington Co's. More or less complaint of chinch bug in wheat.

J[OHNSON], B. F. —Our Illinois Correspondence. (Cultivator and Country Gentleman, June 17, 1886, v. 51, p. 466.)

[Missouri, Kansas, and Nebraska suffering from drouth and chinch bugs. Chinch bugs in Illinois in dry seasons always damage small grain, and frequently, corn.

[WEED, CLARENCE M.] —Seasonable Insect Notes. (Prairie Farmer, June 19, 1886.)

Chinch bugs seriously injurious in Effingham county, Illinois.

FARMERS' REVIEW, June 23, 1886. Seasonable Notes.

A Missouri correspondent writes, "Wheat is an entire failure in our [Barton] county, and in Jasper, and adjoining portions of other counties in Southwest Missouri. Chinch bugs, aided by dry weather, destroying everything."

FARMERS' REVIEW, June 23, 1886. The Crops.

Mention of chinch-bug injury to wheat in Illinois. In St. Clair county very serious. In Dakota county, Minn., drouth and chinch bugs said to have reduced yield of wheat fifty per cent.

STATISTICAL REPORT ILLINOIS STATE BOARD OF AGRICULTURE FOR JUNE, 1886. Circular No. 129, pp. 17-37. Correspondents' Remarks.

Clark, Clay, Franklin, Hamilton, Lawrence, Marion, and Wayne Co's. Wheat more or less injured; in Clay and Wayne counties, very seriously.

INDIANA FARMER, July 18, 1886, v. 20, p. 7.

Supposed attack of chinch bugs on wheat reported from Morgan county, Ind. Last year one field was damaged twenty-five per cent. by this insect.

FORBES, S. A.—Chinch Bugs in Illinois. (Prairie Farmer, July 31, 1886.)

Letter in answer to a correspondent, discussing life history and remedies. No evidence of disease among them. No reason now evident why their injuries should be less next year than they have been this. Wet weather cannot be counted upon. Concerted effort for destruction in winter quarters the most hopeful measure.

Probably not escape them by giving up winter wheat as a crop, as it is very unlikely that they are limited to any of the small grains for support of first brood. Circular of information promised in the fall.

FARMERS' REVIEW. CROP REPORTS.

Aug. 11, 1886. *Edwards and Rock Island Co's.* Corn is being ruined by drouth and bugs. Aug. 25, 1886. *Clinton Co.* "Corn burnt, and eaten up by bugs."

STATISTICAL REPORT ILLINOIS STATE BOARD OF AGRICULTURE FOR AUG., 1886. Circular No. 131, pp. 19-29. Correspondents' Remarks.

Clay, Clinton, Hardin, and Williamson Co's. Corn suffering or nearly ruined by drouth and chinch bugs. *Jefferson and Johnson Co's.* Drouth and chinch bugs have damaged corn. *Crawford, Effingham, Franklin, and Richland Co's.* Corn somewhat injured. *Fayette Co.* Wheat injured. *St. Clair Co.* Destructive in some portions of county. *Washington Co.* Meadows injured. *White Co.* Rain needed to check the chinch bugs.

FORBES, S. A.—The Chinch Bug in Illinois. (Circular from Office State Ent. of Ill., Champaign, Ill., Sept. 10, 1886, pp. 8. Reprinted in *Prairie Farmer*, Sept. 25 and Oct. 2, and in *Western Rural* Oct. 9, 1886.)

The infested area this year includes most of the State south of the Vandalia R. R. line, with center of injury in and about Washington county, where winter wheat was extensively damaged, oats and hay badly hurt, and corn nearly ruined. A brief recapitulation of life history is given and food plants enumerated. Wheat, barley, rye, sorghum, broom-corn, Indian corn, millet, and Hungarian grass are said to be its favorite foods among the crop plants, oats being second to these, while among the wild grasses foxtail grass and "tickle grass" are preferred. Among natural checks upon its increase, unfavorable weather is the most important. This may operate in either of four ways: An open, variable winter may destroy hibernating adults by freezing and thawing; a wet, cool season may promote one of their contagious diseases; the occurrence of heavy rains (especially if cool) at time of hatching may kill vast numbers of the young; or severe drouth, especially in midsummer, may so completely destroy their food plants,—to which end they have themselves contributed,—that they will cease to breed if they do not starve. "Rains take no serious direct effect on the full-grown bugs." Contagious or epidemic disease is the next most effective check upon their increase, two forms of which sweep them away in vast numbers,—one in spring, observed quite carefully by Dr. Shimer in 1865, excessive moisture being favorable to it, and one in fall, discovered by writer in 1882, not stimulated apparently by wet weather. Bird and insect enemies need not be considered in a practical discussion, their influence upon the numbers of the chinch bug is so slight.

"In estimating probabilities of continued damage we must take account of the following facts:" Two successive years of chinch-bug outbreak have seldom occurred in the same territory; the breeding of the chinch bug has been cut short by a scarcity of food, their injuries and the drouth having nearly ruined the corn; there is a chance for a variable winter and a wet spring or even summer, dry weather having prevailed to a great extent in Southern Illinois for several years; disease may yet prevail, although there is no immediate promise; there is a sufficient number of bugs maturing, or about to mature, to overwhelm the country they now occupy and to greatly extend their area of devastation should the greater part of them live till spring and breed; and, consequently, the weather is practically the determining factor for the next year. Sufficient prospect of injury next year to make remedial and preventive measures imperative, and the following are recommended: (1) abandonment of small grain for a year where corn is principal crop, to starve out first brood; (2) abandonment of corn for a year where small grains are the principal crop, to cut short food of midsummer brood; (3) destruction in winter quarters; (4) heavy manuring; (5) heavy seeding; (6) sowing clover in wheat fields; (7) sowing Hungarian grass as lure; (8) "strewing powdered lime around edges of corn fields to prevent entrance of bugs on foot"—practiced successfully in one instance in Washington county; (9) plowing furrows around fields or making belt of coal-tar, irrigating infested fields, and killing bugs with diluted kerosene emulsion,—these last, "measures of little promise or considerable expense" which may sometimes be useful. The artificial cultivation and spread of the germs of the contagious diseases of these insects is as yet only a theoretical remedy. Some of the foregoing measures may be taken to advantage by the individual farmer; others are of little or no avail unless action is concerted.

[WEED, CLARENCE M.]—Southern Illinois Notes. (Prairie Farmer, Oct. 2, 1886.)

Mention of great damage to farm crops in Southern Illinois by chinch bugs and drouth.

BALDWIN, ELMER, AND FORBES, S. A.—Chinch Bugs and Spring Wheat. (Prairie Farmer, Oct. 9, 1886.)

Mr. Baldwin contends that spring wheat is the favorite breeding crop of the chinch bug, "and is responsible for its first introduction and rapid increase in every locality. This may not be true of every locality, but I know it is of this" [La Salle Co., Ill.]. Prof. Forbes calls attention to outbreaks in Southern Illinois, where no spring wheat is grown, and records instances of its breeding freely and successfully in early oats and corn. He adds that as it rarely occurs in destructive numbers for more than one or two years in the same locality, whatever the agricultural practice, any general measure is likely to receive more credit than is due to it.

MATTHEWS, A. L.—Spring Wheat and Chinch Bugs. (Prairie Farmer, Nov. 6, 1886.)

Writing from Reno Co., Kan., says: "I came to this county before there was a crop of any kind of grain raised here, and I found the chinch bugs so thick that I could scrape them up by the double handful. I have known them to do more damage in winter wheat, corn, oats, and millet in this locality than they ever did in spring wheat to my knowledge." Believes some varieties of spring wheat more subject to chinch-bug ravages than others. Some spring wheat has more tender straw than others.

PRAIRIE FARMER, Nov. 13, 1886. Entomological Progress in Illinois.

Mention of Prof. Forbes's studies of the chinch-bug outbreak in Southern Illinois.

STATISTICAL REPORT ILLINOIS STATE BOARD OF AGRICULTURE FOR DEC., 1886. Circular No. 132, pp. 20-36. Correspondents' Remarks.

Bond, Fayette, Franklin, Gallatin, Hamilton, Madison, Marion, Monroe, Saline, Union, Wabash, Wayne, and Williamson Co's. Drouth and chinch bugs have injured corn more or less seriously in the foregoing counties—50 per cent. in Hamilton, 10 per cent. in Union.

VAN DUZEE, E. P.—Occurrence of the Chinch Bug (*Blissus leucopterus*, Say) at Buffalo, N. Y. (Can. Ent. v. 18, p. 209; Rept. Ent. Soc. Ont., v. 17, p. 20.)

Abundant at Buffalo for many years. Took it in 1874 at Lancaster, N. Y.; also taken at Ridgeway, Ont. "Ordinarily the short-winged form predominates, but in hot, dry summers, such as those of 1881 and 1886, they mostly acquire fully developed membranes. I find on comparison with a lot of perhaps one hundred fully developed examples from Kansas, that ours are quite uniformly larger and more robust, with longer hairs on the pronotum." Some hay fields injured this year. "Have always found the insect in hay fields, generally in timothy or clover, occasionally among wild grasses. Do not recollect ever taking a specimen in a grain field of any kind."

WEBSTER, F. M.—Insects affecting the Corn Crop. (Rept. Ind. State Board of Agriculture, 1885, p. —; Author's edition, p. 15.)

Short compiled general article.

FORBES, S. A.—The Entomological Record for 1885. (Miscellaneous Essays on Economic Entomology, by the State Entomologist [of Ill.] and his Entomological Assistants, pp. 5, 23.)

The chinch bug has been upon the increase in certain parts of the State, and unless unfavorable weather should interpose a check

upon its multiplication it may, in Southern Illinois, "overpass the limit of insignificance before another year." Reference to report of injuries in August Crop Report.

HUNT, THOMAS F.—Partial Bibliography of Indian Corn Insects. The Chinch Bug. (Miscellaneous Essays on Economic Entomology, etc., pp. 112–116.)

Partial bibliography of chinch bug.

1887.

FORBES, S. A.—Insects affecting Corn. [Extract from lecture before Farmers' Institute, Champaign, Ill., Feb. 3, 1887.] (Prairie Farmer, Feb. 26, March 5, and [The Mission of Entomology] March 26, 1887.)

Tracing the effect of the development of agriculture in Illinois upon the various classes of corn insects, the important differences seem chiefly due to two causes; the cessation of the prairie fires of the Indians and the general substitution of corn for the prairie grass. In the face of these autumnal fires no insect which by its habits was thus exposed to great diminution could possibly maintain itself, unless, like the chinch bug and army worm, it had a high rate of multiplication. Such insects inevitably became the worst pests of agriculture.

J[OHNSON], B. F.—[Note from Champaign Co., Ill., Mar. 9, 1887.]

Very heavy rains in southern part of the State. Wheat on light clays materially damaged by chinch bugs last fall.

FORBES, S. A.—The Chinch Bugs. (Greenville, Bond County [Ill.] Advocate, March 24, 1887.)

Says to newspaper reporter that chinch bugs in the county seem to have come through the winter in good condition, and that unless the weather should prove unfavorable they will probably do much damage. He urges burning over headlands and grassy tracts where they are collected in their winter quarters.

FORBES, S. A.—The Chinch Bug in Southern Illinois. (Circular. from Office State Ent. Ill., Champaign, April 15, 1887. Reprinted in Prairie Farmer April 30, 1887.)

Danger of chinch-bug ravage has by no means passed. Where corn was generally destroyed last year, the second brood was cut short for lack of food; but where the damage was less serious the bugs have hibernated in threatening numbers. No unusual natural check upon their increase has been detected. Quick, stimulating fertilizers are recommended for infested small grain not absolutely overwhelmed by attack, and a formula furnished by the chemical department of the University is given for trial; viz., "one hundred pounds each of nitrate of soda, superphosphates, and muriate or sulphate of potash, to be thoroughly mixed, and sown at the rate of from 150 to 300 pounds to the acre, the mixture costing

from \$2 to \$2.50 per hundred." Salt is also recommended for experiment—100 to 200 pounds to the acre. Lime sowed freely along edges of corn fields adjacent to small grain may probably prevent invasion at harvest. It is also stated that, as an experiment, strips of Hungarian grass will be sown in May and June "between the outer rows of corn likely to be invaded, with the intention of tempting the bugs to deposit their eggs on this, their favorite food and breeding plant, and destroying the young of the second brood as they hatch, by the free application of caustic lime."

J[OHNSON], B. F.—Our Illinois Correspondence. (Cultivator and Country Gentlemen, Apr. 21, 1887, v. 52, p. 318.)

Writes from Champaign Co., Apr. 12, that the present warm and dry weather is favorable to the activity of the chinch bug. Quotes State Entomologist to the effect that there is this year little danger of damage by the chinch bug in Central Illinois.

STATISTICAL REPORT OF THE ILLINOIS STATE BOARD OF AGRICULTURE FOR MAY, 1887. Circular 134, pp. 14, 16. Correspondents' Remarks.

Edwards, Jasper, and Jefferson Co's. More or less complaint of chinch bugs in winter wheat.

FARMERS' REVIEW. CROP REPORTS.

May 18, 1887. *Madison Co.* Corn and oats injured. *Williamson Co.* Chinch bugs injuring winter wheat. May 25, 1887. *Bond, Jasper, and Jefferson Co's.* Winter wheat damaged by chinch bugs. *Mercer Co.* But few chinch bugs. June 8, 1887. *Crawford, Fayette, Hardin, Madison, Marion, Perry, Wayne, and White Co's.* Winter wheat more or less damaged by chinch bugs. June 22, 1887. *Bond Co.* "Chinch bugs numerous and affecting crops more or less. Winter wheat, condition, 100 per cent." *Clark, Jackson, Richland, and Monroe Co's.* Winter wheat damaged. *Jefferson Co.* Some bugs in oats. July 6, 1887. *Effingham Co.* Corn and oats injured by dry weather and bugs. *Madison Co.* Chinch bugs killing corn and oats. *Pulaski Co.* Corn damaged. *Wayne Co.* Wheat damaged. *Washington Co.* Some chinch bugs. July 13, 1887. *Johnson, Shelby, Marion, and Wayne Co's.* Damage to corn by chinch bugs, and in some localities by drouth also. *Kendall and Knox Co's.* Spring wheat damaged by drouth and chinch bugs. July 20, 1887. *Bond, Edwards, Morgan, Jefferson, and Jasper Co's.* Corn and oats damaged by drouth and chinch bugs. *Montgomery and Perry Co's.* Corn damaged by drouth and bugs. *Peoria Co.* Some chinch bugs in spring wheat. *Pope Co.* Some chinch bugs in oats. July 27, 1887. *Carroll Co.* Spring wheat damaged by drouth and chinch bugs. *Fayette, Lawrence, and Macoupin Co's.* Corn damaged by drouth and chinch bugs. *Franklin Co.* Some damage to oats by bugs and drouth. *Johnson Co.* Winter wheat and oats damaged by bugs. Aug. 10, 1887. *Perry and Shelby Co's.* Corn damaged by

drouth and a few chinch bugs. Aug. 31, 1887. *Clinton, Effingham, Madison, Pulaski, Washington, and Wayne Co's.* Corn damaged by drouth and chinch bugs.

WEBSTER, F. M.—Insects affecting the Smaller Cereal Grains. (Rept. Ind. Agric. Dept., 1886, p. 183, plate V., figures 4, 5.)

Hibernates as an adult wherever it can find protection from the elements. Emerges from March to middle of May (according to locality) and deposits eggs,—each female about five hundred. The insects reach maturity in about two months, and then, pairing almost immediately, deposit eggs for a second brood. Their relative abundance depends on meteorological conditions, dry summers and winters of even temperature being favorable to them, and wet springs and summers and open winters unfavorable. Burning grass, leaves, and rubbish during winter or early spring best preventive measure. To check migration, plow furrow or use tarred boards on edge.

HINMAN, D.—Destroying Chinch Bugs. (*Prairie Farmer*, June 11, 1887.)

"Have fought chinch bugs in two ways. The first is to plow them under deeply with stirring plow. To insure all bugs being plowed under, a chain should be so attached to the plow and the singletree of the horse in the furrow that all weeds, etc., will be turned under. The second way is by applying salt. Sowed it broadcast on a patch of Hungarian grass, at the rate of two bushels to the acre. It stopped their work effectively. I tried the same remedy in a corn field which they had just attacked, with like results. I believe salt will stop them if put on in time."

J[OHNSON], B. F.—Our Illinois Correspondence. (*Cultivator and Country Gentleman*, June 16, 1887, v. 52, p. 472.)

□Champaign Co. June 9. "Referring to the drouth now prevailing west, I learn from parties who recently returned from extensive tours through Central and Southern Kansas, that as far west from Kansas City as the great bend of the Arkansas line, about 99° longitude, the wheat and oats are not worth twenty-five cents an acre,—due to drouth and chinch bugs; that corn is looking well, but ready to receive the bugs when wheat and oats give out; also that a considerable portion of Nebraska is suffering the same affliction."

STATISTICAL REPORT OF THE ILLINOIS STATE BOARD OF AGRICULTURE FOR JUNE, 1887. Circular 135, pp. 16-37. Correspondents' Remarks.

Clark, Clay, Crawford, Gallatin, Jackson, Jefferson, Union, Washington, Wayne, and White Co's. Winter wheat more or less injured by chinch bug, re-enforced in many localities by the Hessian fly.

STATISTICAL REPORT OF THE ILLINOIS STATE BOARD OF AGRICULTURE JULY 1, 1887. Circular 136, pp. 12-23. Correspondents' Remarks.

Bond, Clark, Clay, Jefferson, and Shelby Co's. Corn and oats injured by chinch bug. *Coles and Madison Co's.* Oats injured. *Clinton, Crawford, Effingham, Franklin, Hamilton, Jackson, Lawrence, Macoupin, Richland, Wayne, and Williamson Co's.* Corn more or less injured. *Fayette, Jasper, Perry, St. Clair, Wabash, and Washington Co's.* Chinch bugs and drouth have injured corn.

CHICAGO TRIBUNE, July 11, 1887. The Chinch Bug.

Reports from thirty-three counties in Wisconsin show that crops have been seriously damaged by chinch bugs in ten counties and by chinch bugs and drouth in nine others.

FORBES, S. A.—[The Chinch Bug.] (A circular letter issued from the office of the State Entomologist of Illinois, July 19, 1887.)

In Southern Illinois thirty counties are said to be infested by the chinch bug, and it is found locally numerous in the northern part of the State in Lake, Winnebago, Stephenson, and Lee counties. Information is requested concerning occurrence and numbers.

BOAS, F., AND [WEED, C. M.]—Questions Answered. (Prairie Farmer, July 23, 1887.)

Writing from Marion county, Ill., Mr. Boas says: "The chinch bugs have taken our oats, a great deal of our timothy, and are now ready for the corn. * * * Last year I had a prospect of 1,500 bushels of corn, but the chinch bugs reduced it to less than 150." Asks concerning the practicability of killing the bugs with pyrethrum. Mr. Weed replies that it will be difficult to reach those concealed beneath the sheaths of the leaves, and recommends the kerosene emulsion as cheaper and more likely to give good results, and gives formula for preparing it.

[WEED, C. M.]—Chinch Bugs in Northern Illinois. (Prairie Farmer, July 23, 1887.)

Recent investigations of the State Entomologist show an incipient outbreak of chinch bugs in certain counties of Northern Illinois. Considerable damage to corn and oats about Freeport, in Stephenson county. Probability of an overwhelming attack in 1888 if the weather should be favorable.

FARMERS' REVIEW, July 27, 1887. Plowing under Chinch Bugs.

A Kansas farmer who plowed under the outside rows in a corn field which had been attacked when adjoining wheat was cut writes: "My plowing under the chinch bugs was a complete fail-

ure. They crawled out and traveled into fresh corn and devoured still more; but at this time the most of them have wings and make use of them."

PRAIRIE FARMER, July 30, 1887. [Chinch Bugs in Minnesota.]

A correspondent from Goodhue Co., Minn., writes that "wheat is almost an entire failure on account of chinch bugs. Barley and oats will be about three fourths of a crop. The bugs are so numerous in some places that it is impossible to keep them out of houses and cisterns."

MONTHLY WEATHER REVIEW OF THE ILLINOIS STATE WEATHER SERVICE FOR JULY, 1887. Weather Crop-Bulletins, pp. 13-15. Condition of Crops.

June 11. Chinch bugs damaging corn in *Clinton Co.* June 18. Continue to damage the crops in *St. Clair, Washington*, and other southern counties. June 25. In *Marion Co.*, damaging ripening oats. July 2. Corn being damaged severely in *Madison, Effingham*, and *Wayne* to *Randolph Co's.*; and this crop seems doomed in *Clinton* and *Effingham Co's.* July 9. Great damage to corn in *Shelby Co.*, and in the whole southern part of the State.

CULTIVATOR AND COUNTRY GENTLEMAN, Aug. 4, 1887, v. 52, p. 601.
Headed off Chinch Bugs.

A correspondent protected corn by plowing furrow around field and setting up boards edgewise and wetting with kerosene. When corn is already damaged, plowing a furrow against the row and dressing with a hoe will check the bugs until fodder can be grown.

PRAIRIE FARMER, Aug. 6, 1887.

"Do not allow your cattle to eat much green corn thickly infested by chinch bugs. A few years ago much injury to stock was reported from this cause." [See foot-note p. 47.]

FORBES, S. A.—Chinch Bugs in Illinois. (A letter to the Secretary of the State Department of Agriculture, *Prairie Farmer*, Aug. 6, 1887.)

Imminent danger of a chinch-bug outbreak in several counties of Northern Illinois next year, where, locally, wheat and corn have been damaged this season. Ravages in Southern Illinois continue uninterrupted, and the weather conditions in Central Illinois are peculiarly favorable to the multiplication of the chinch bug. A general outbreak throughout the State seems threatened.

H., C. L.—FROM SOUTHERN MINNESOTA. (*Cultivator and Country Gentleman*, Aug. 11, 1887, v. 52, p. 618.)

Freeborn Co., Minn., July 27. Harvest hastened by chinch bugs. More or less damage also in several counties adjacent. Serious injury confined to eight or nine southeastern counties. Injury done in adjoining parts of Wisconsin and Iowa. Hot dry weather of May favored hatching of eggs. If second brood is similarly favored, it will be unwise to sow much wheat next spring. No

successful remedy unless it be starvation by general refusal to sow their favorite food plants in districts where they are present. Will damage corn this year locally, but not enough to affect the general crop.

FARMERS' REVIEW, Aug. 17, 1887. A Crusade against Insects.

Correspondent from Red Bud, Randolph Co., Ill., advises concerted action by neighborhoods against chinch bugs and other insects; closely mowing old stubbles, weeds, and grain left standing, before plowing, and burning them clean when dry. Would also remove old fences and clear and burn off the ground before replacing the fence. Speaks favorably of strips of oats, and especially of flax, between wheat and corn, and of the use of lime fertilizers.

J[OHNSON], B. F.—Our Illinois Correspondence. (Cultivator and Country Gentleman, Aug. 18, 1887, v. 52, p. 636.

A wet season is the only efficient check on the chinch bug. For the last fifty years these insects have appeared in Central Illinois during the dry seasons and disappeared in the wet seasons.

CHAMBERLAIN, W. I.—The Iowa Drouth. Definite Facts. (Cultivator and Country Gentleman, Aug. 25 and Sept. 1, 1887, v. 52, pp. 652, 690.)

Chinch bugs first noticed in Hungarian July 13. Stopped growth for two weeks. Second brood destroyed the grass. The young bugs in four cubic inches of earth with Hungarian roots numbered 3,025 by count. Farmers questioning advisability of raising spring wheat or Hungarian. Field corn on college farm damaged about twenty-five per cent.; fodder corn on turf about seventy-five per cent. Hungarian yielded only half a ton per acre on very rich soil. Three furrows plowed three feet apart and pulverized by dragging log failed to arrest movement of chinch bugs, although many died in the furrows. Attempt to destroy in Hungarian by mowing the grass and burning partly failed on account of wet weather. Bugs killed with kerosene emulsion on outer rows of corn by using garden force-pump from wagon. Concludes that man is really and practically powerless against this insect when it appears in force in a dry season. Believes the only remedy is to refrain from raising its favorite crops, especially spring wheat and Hungarian. Both corn and Hungarian much worse attacked on sod than on old ground.

STATISTICAL REPORT OF THE ILLINOIS STATE BOARD OF AGRICULTURE FOR AUGUST, 1887. Circular 137, pp. 15-28. Correspondents' Remarks.

Clinton, Crawford, Cumberland, Douglas, Fayette, Franklin, Hamilton, Jefferson, Johnson, Madison, Saline, Shelby, Washington, Wayne, and Whiteside Co's. Corn damaged by drouth and chinch bugs; nearly ruined in many localities. *Alexander Co.* Oats injured. *Jackson Co.* Rain has checked chinch bugs. *Macoupin and Perry Co's.* Small grain injured. *Marion Co.*

Wheat nearly ruined; corn damaged. *Montgomery Co.* Corn and oats badly injured. *Richland Co.* Corn on high lands nearly ruined.

MONTHLY WEATHER REVIEW OF THE ILLINOIS STATE WEATHER SERVICE FOR AUGUST, 1887, pp. 9, 10. Condition of Crops.

Aug. 20. "There has not been for years such serious and general complaint of the damage resulting to corn from chinch bugs."

Aug. 27. Excepting Pulaski, the counties of the southern part of the State report from less than one fourth to one half an average crop of corn, owing to chinch bugs and drouth.

TRUESDELL, J. A.—Preventive for the Chinch Bug. (*Cultivator and Country Gentleman*, Sept. 1, 1887, v. 52, p. 673.)

To protect uninfested grain, drill in thickly, all round the field, a strip of ordinary field corn a rod or two in width. If a good stand of corn is obtained by June 15, the protected field will not be invaded. A heavy sowing of salt is a check. Burn the corn stubble if there is any left.

J[OHNSON], B. F.—Our Illinois Correspondence. (*Cultivator and Country Gentleman*, Sept. 1, 1887, v. 52, p. 690.)

Concludes from Mr. Chamberlain's observations that chinch bugs cannot be controlled by any human means, but that the weather alone can reduce their outbreaks. Liberal rainfall since 1881 has restrained this pest in Central Illinois. Wheat generally replaced by oats on the bluff lands along the Mississippi, Ohio, and Wabash on account of the chinch bug.

FARMERS' REVIEW, Sept. 14, 1887. Plan for a Crusade against Destructive Insects.

A Kansas farmer outlines the following procedure: Plow under land this fall, and in spring plant only so much ground as can be well manured and such crops as the chinch bug will not infest; viz., red clover, flax, potatoes, and castor beans. Let residue of land remain fallow until about the time of the hatching of the first brood, then turn under all grass and weeds. If this plowing does not destroy the young bugs it will do the land no harm. Follow with harrow and drag, and crab grass for hay may be expected.

FARMERS' REVIEW, Sept. 14, 1887, v. 18, p. 588.

Correspondent from Zumbra Falls, Minn., reports that chinch bug ravaged that section terribly the past season. Editors indorse Mr. Chamberlain's recommendation of abandonment of wheat, Hungarian, etc. "Farm for corn, cattle, dairy products, hogs, and colts."

CHAMBERLAIN, W. I.—The Drouth in Central Iowa. (*Cultivator and Country Gentlemen*, Sept. 15, 1887, v. 52, p. 708.)

Corn cut prematurely on account of chinch-bug attack. Would have been very large but for this.

[WEED, C. M.]—Chinch Bugs. (Prairie Farmer Sept. 17, 1887.)

No practical way of getting rid of the pest yet discovered. Where wheat is grown other crops are jeopardized. "Diversified farming, with wheat mainly left out, is the best practice we now know of."

WEBSTER, F. M.—Insect Enemies of Crops. The Outlook. (Farmers' Review, Sept. 28, 1887.)

Objects to statement made in previous issue of paper (Sept. 14) that abandonment of wheat as a crop will banish the chinch bug. The experience of southern planters is directly to the contrary. In Louisiana, where no wheat or barley is raised, corn is sometimes damaged. As to chinch-bug prospects for another year, it is scarcely less a meteorological than an entomological problem; consequently it is very difficult and almost useless to predict.

INDIANA FARMER, Oct. 15, 1887, v. 32, p. 14. Chinch Bugs.

Appear in continuous dry weather. A few weeks of open, moist weather kills them. Favorite breeding place, wheat fields. Will not thrive where soil is strong and vegetation rank. Writer saw them first in Edwards county, Ill., in 1855. Probably has been no year in the past twenty in which a few chinch bugs could not be found in wheat.

WATERS, G. W.—The Chinch Bug. (Farmers' Review, Oct. 19, 1887, v. 18, p. 658.)

Chinch bugs seek winter quarters uniformly in some damp place,—not in dry fodder, etc. Wet weather in winter or an open winter does not hurt them. The winter of 1881-82 was excessively wet and they came forth in the spring "by the bushel." Bugs immersed for a week or more on ears of corn in fodder which had fallen into water and was frozen over with ice, were lively when warmed by the sun. One lot lived in a jar of wet earth for a month without food. Argues, with Mr. Webster, that abandonment of wheat and oats as crops will not stop their ravages. Strips of rye or spring wheat may serve as traps in the spring, and, if plowed under in moderately damp weather, the insect will not come out; but if eggs are laid, they may hatch and young bugs come to the surface.

WEBSTER, F. M.—The Chinch Bug. (Farmers' Review, Nov. 23, 1887.)

Refers to letter by Mr. Waters in issue of Oct. 19, as interesting and evincing a commendable spirit of investigation. Calls attention to the facts that chinch bugs feed on native prairies and that outbreaks may occur in timothy meadows,—as in

New York, in 1882 and 1883. Burning grass and rubbish destroys a few bugs and deprives the remainder of shelter. Much of the grass will not be burned, but sheep, if the farmer has them, will eat it so close as to leave no shelter for bugs. In warmer portion of the country no doubt many eggs are deposited in the fall. The bugs seek the higher parts of a field, because dampness is fatal to young and eggs. Strips of crop to trap them should be sown in such places. Careful experiment for controlling chinch bug always in order, but hasty, wholesale abolition of the cultivation of one of our most important cereals, without proof of its efficiency, seems an injudicious measure.

PRAIRIE FARMER, Dec.—, 1887. Destroying Chinch Bugs.

The following dispatch to the Chicago papers from Hillsboro, Illinois, quoted: "A number of farmers here, acting on the advice of the State Entomologist, are burning off their fields and wood pastures for the purpose of destroying the myriads of chinch bugs that ruined the corn crop of last season. An effort is being made to make the burning general."

PRAIRIE FARMER, Dec. 24, 1887. Burning Corn Stalks to destroy Chinch Bugs.

Thought to be impracticable, as early in fall the bugs leave the corn stalks and take shelter in grass in edges of fields, under rails and leaves, in woods, etc. Burning in hiding places recommended.

S. A. FORBES.—On the Chinch Bug (*Blissus leucopterus*, Say) in Illinois. Present Condition, and Prospects for 1887 and 1888. Remedial Procedure Recommended. (Bull. No. 2, Office State Ent. of Ill., pp. 27-43. Extracts, abstracts, or comments, in the following papers: Fruit Growers' Journal, Oct. 1 and 15, 1887; Review Dispatch, Sept. 23, 1887; Prairie Farmer, Oct. 1, 8, 15, 1887; Chicago Daily Inter Ocean, Sept. 17, 1887.)

Chinch bugs extraordinarily destructive for three successive years in Southern Illinois, infested area gradually increasing until it includes the greater part of thirty counties. Careful search in Northern Illinois showed it to be locally numerous in Lake, Winnebago, Stephenson, and Lee counties, and occasionally injurious to corn and oats adjoining wheat and barley, breeding in both winter and spring wheat. Reported present in Rock Island county in great numbers, and attracting attention in many parts of Central and Western Illinois. Weather conditions throughout the State this year, and in Northern, Southern, and Western Illinois last year, have been generally so favorable to the multiplication of the chinch bug that the State is threatened with great loss. Timely concerted action suited to the emergency is urged. Notes from crop correspondents in answer to circular of inquiry are given, from which it appears that the chinch bug is very destructive in thirty counties; occurs in large numbers in sixteen; in moderate

numbers in seventeen; and in numbers sufficient to threaten harm another year in twenty-five; while from thirteen counties it is practically absent. Life history briefly rehearsed and food plants given. The tendency, especially in the southern part of the State, to regard chinch-bug devastations as inevitable is noted, and some reasons for it given, among which are the following: (1) The number of worthless recommendations that have been made tend to discredit the whole subject of remedial measures. (2) There is ignorance concerning the remedies which have here and there been tried with encouraging results. (3) Measures which have failed under exceptional circumstances or because not thoroughly applied have been set aside as worthless. (4) The failure of individual efforts has discouraged people from concerted action. (5) *Preventive* measures have been brought into disrepute because these measures have failed when applied as a *remedy*. (6) Expedients that accomplish much have been neglected because they did not do more. (7) Many promising measures still lack the endorsement of accurate, practical experiment. (8) There is a disposition to speculate on the weather and to count on its being unfavorable to the chinch bug. Under the three heads, agricultural methods, barriers against migration, and direct destruction, remedial and preventive measures, to the number of thirty, are treated very fully, the standard methods being rehearsed, some others suggested, and old ones emphasized by record of experiments. Winter wheat is said to afford every necessary opportunity for the multiplication of the chinch bug; and the temporary abandonment of corn in regions where small grains are the principal crop is mentioned as an expedient for forcing the midsummer brood to desert the fields and resort to woodlands for food. For those parts of the State not practically mastered by the chinch bug a special procedure is recommended.

Cook, A. J.—Insects Injurious to Grasses and Clovers. (Grasses of North America, v. 1, p. 408.)

The chinch bug often does millions of dollars' worth of damage in Illinois, Iowa, Missouri, and Kansas. It is more susceptible to seasonal peculiarities—especially to wet weather—than most insects. Gives short description of the stages and times of appearing. Two- or three-brooded. Neatness in farm operations, leaving no hiding places for them to winter in, is about the only remedy possible. Kerosene emulsion will kill them, but is hardly a practical remedy.

STATISTICAL REPORT OF THE ILLINOIS STATE BOARD OF AGRICULTURE FOR DECEMBER, 1887. Circular 138, pp. 21-34. Correspondents' Remarks.

Clark, Crawford, Hamilton, Pope, Richland, Saline, St. Clair, Union, Washington, and Williamson Co's. Corn much injured by drouth and chinch bugs.

BRUNER, LAWRENCE.—[Extracts from Western Newspapers of 1886.]
(U. S. Dept. of Agriculture, Division of Entomology, Bull.
13, 1887, pp. 35-37.)

Alexander, Bond, Edwards, Jefferson, and Monroe counties in Southern Illinois report great injury from chinch bugs; and Grenola [Elk?], Franklin, and Panorama [?] counties in Kansas; Felton [Fulton], and Highland, in Ohio; and Howard in Indiana, report considerable injury. ("Farmers' Review Crop Summary for May 30, printed in advance in "Omaha Daily Bee," May 31, 1886.)

Under dates of July 2, 9, and 10, and Aug. 5, 1886, the following counties in Nebraska report injury to wheat, in three instances to oats, and in one to corn: Adams, Clay, Fillmore, Howard, Saline, Saunders, and York. Under date of July 16, chinch bugs are reported to have destroyed much wheat and oats in Webster county, Iowa.

1888.

OSBORN, HERBERT.—The Chinch Bug in Iowa. (Bull. Iowa Agric. Coll., Dept. Ent. Jan. 1888, p. 13. Published in part in 1887 in Coll. Rept.)

Damage by chinch bugs in Iowa in 1887 nearly \$25,000,000. Summary of life history and habits, and detailed account of observations at Ames. First damage noted in June, to wheat. On corn and Hungarian the middle of July, mostly in adult and pupa stages; many adults pairing at this time. Seen taking wing July 16. Eggs plenty in ground at base of corn stalks, between sheaths, etc., July 19, some nearly ready to hatch. July 25 and 27 swarming, flying with the wind: no pairing noticed. Aug. 3, newly hatched bugs plentiful; some on corn, but more on roots and stems of foxtail grass. Hungarian, late-planted on sod, suffered severely. Weather dry. Aug. 13, bugs were going from the Hungarian to corn. As late as Nov. 15 adults were in the fields. Kerosene emulsion, five or six per cent., killed the bugs very quickly; less than four or five per cent. was unsatisfactory. Can hardly prove of value except when bugs are massing on corn. Great numbers were destroyed by burning stubble and grass. Fire should be started in hottest part of day, when greatest numbers will be moving. A couple of furrows plowed between grass and corn and kept pulverized were effective. To prevent migration from wheat to corn, furrows should be plowed several days before migration begins, two or three time pulverized, and as soon as there is any sign of migration, a weighted trough should be drawn along the furrow to reduce the sides to dust, this process to be repeated every dry, hot day, by ten o'clock, as long as bugs attempt to pass. Experiments were made with pyrethrum and bisulphide of carbon, the former proving entirely unsatisfactory and the latter needing further trial. Preventive measures must be the main

reliance. Quotes from recent bulletin of Prof. Forbes some of the commonest causes of discouragement as to measures of defence, and recommends the following procedure for 1888: Carry fire into every hiding place that circumstances will permit. Reduce as much as possible the area planted to wheat, rye, barley, and Hungarian, and, to a less extent, oats, corn, and meadow grass; but where these crops cannot be suspended, sow small grain early and heavily, and plant corn late, and if it is unavoidably planted next to wheat, barley, or Hungarian, sow between the fields strips of some crop not relished by bugs. As far as practicable, make clover, buckwheat, flax, beans, and root crops the main dependence. Strips of wheat or Hungarian may be planted as lures and plowed under as soon as eggs are laid, lying two or three weeks unless the crop to be planted subsequently is one bugs will not eat. When portions of a field become badly infested before much growth has been made, plow under deep, and, later, plant to some crop bugs will not injure, or, as late as possible, to fodder corn. If crop is far enough along to cut as hay, or ripe enough for early cutting for grain, clear field at once, burn stubble, and plow quickly. Make furrows and pulverize earth to prevent migration from small grain to corn. Straw may be spread along these furrows toward evening and fired in the morning. If bugs reach corn and begin to accumulate, use kerosene emulsion. Process of preparing and applying emulsion given. Corn fields infested throughout may be cut for fodder. After the crops are cared for, rubbish in places inaccessible to fire may be raked into heaps, and these will attract the bugs when selecting quarters for hibernation. Here they may be burned in late fall, early winter, or early spring. Also burn over ground covered with grass, leaves, etc. Concert of action urged.

KANSAS FARMER, ———, 1888. [Fighting the Chinch Bug.]
(Reprinted in Farmers' Review, Jan. 4, 1888.)

Two plans. 1. With a stirring plow turn one furrow in advance of bugs and away from them. On top of ridge made by plow level off a width of four inches, making smooth and compact, and apply coal-tar with any vessel that will give a stream a little larger than a rye straw. For first few days make two applications,—morning and 'noon,—after which one at midday and after rain will suffice by its scent to check any number of bugs that may approach. Knows from two seasons' experience that a continuous tar-line, free from sticks, weeds, or stalks, will protect any crop from the bugs until they can fly. Coal-tar, \$2.50 to \$4 per barrel, according to freight charges. After practice, fifteen minutes will suffice to renew a line of tar ninety to one hundred rods long. After the ground has become well-saturated and hard the stream may be diminished.

2. In fall sow half acre of rye on highest land on farm, covering in winter with sufficient hay or straw to secure its burning well. The eggs will be deposited on the rye, and when they have

hatched, on some warm day fire the straw. If the rye doesn't burn, sprinkle stubs with Spanish green. Three years of this procedure will practically exterminate the bugs.

VAN W., R. A.—To Destroy Chinch Bugs. (Farmers' Review, Jan. 18, 1888.)

Advises destroying chinch bugs on corn and millet, after harvest, with kerosene and fire.

FORBES, S. A.—The Chinch Bug. (Freeport Journal, Feb. 15, 1888.)

Reporter's abstract of paper read before Farmers' Institute at Freeport.

STATISTICAL REPORT OF THE ILLINOIS STATE BOARD OF AGRICULTURE, MAY 1, 1888. Circular 139, pp. 16-24. Correspondents' Remarks.

Johnson, Marion, Massac, Richland, White, and Williamson Co's. Chinch bugs reported as injuring winter wheat.

HOWARD, L. O.—The Chinch Bug: A General Summary of its History, Habits, Enemies, and of the Remedies and Preventives to be used against it. (Bull. No. 17, Div. Ent. U. S. Dept. Agric., p. 48; Rept. [U. S.] Commiss. of Agriculture, 1887, pp. 51-88, Plates I., III.; Farmers' Review, May 9, 16, 30, and June 6 and 13, 1888.)

A complete review of the subject to meet the demand for information not now generally accessible. The well-known Missouri Reports are quoted from at length, and other previous writings laid under contribution, and the note books and records of the Division of Entomology have been at the author's disposal. The history of the insect is outlined, estimates of loss are given, and 1881 is mentioned as the year in which, at the "Chinch Bug Convention" held at Windsor, Kan., it was decided to cease raising wheat. The interesting point in the season of 1887, is said to be the occurrence of the chinch bugs in immense numbers in parts of Virginia and the Carolinas for the first time in many years. A report by the statistician of the U. S. Department of Agriculture is presented, from which it appears that the chinch-bug damage to corn, wheat, and oats in Kentucky, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, and Kansas in 1887, exceeded \$54,000,000, the total loss, including damage to barley, rye, and millet, being approximately stated at \$60,000,000. Insect indigenous east of the Rocky Mountains, and found in California in very limited, not injurious, numbers. Outside of United States, specimens are recorded from Canada, Cuba, and Mexico. Wild buckwheat is added to the list of food plants on the strength of testimony from Nebraska by Mr. Lawrence Bruner; mention is made of adult specimens' being found in cultivated rice in Georgia in 1881; and upon the sand oats (*Uniola paniculata*) in Florida the insect is said to undergo its entire de-

velopment on the highest part of that tall plant, owing probably to the blowing of fine sharp sand through lower part of plants. Description of different stages from Riley's Seventh Report. A variety of the species having slender, pointed wing-pads and peculiar colored antennæ is mentioned as collected on sea-shore only. Two-brooded above the latitude of St. Louis, but unquestionably a third generation (hibernating probably in adult condition) in North Carolina, and some evidence of such a one in Southern Illinois and Kentucky. Hedges mentioned as affording exceptionally good hibernating places, and their gradual removal recommended. Insects fly in spring and fall, at the latter time impelled by hunger. Habits described at length. Mention made of 3,025 bugs' being counted on a single root of Hungarian grass dug up in Iowa, displacing about four cubic inches of earth. The statements which have gained currency concerning the laying of eggs in autumn and their hatching the following spring, are said to be erroneous, at least for the West and North. Beside the usual enumeration of insect enemies, an observation by Mr. F. M. Webster is recorded, which seems to indicate that a species of *Mermis* ("hair-snakes") may be found to infest the chinch bug. Observations of Mr. Bruner and stomach dissections by Prof. Forbes, seem to indicate that lady-birds have been overestimated as chinch-bug destroyers. Among vertebrate enemies the common frog is mentioned, and several birds, including the quail, which it is said should be better guarded by game laws, or, as in Colorado and Dakota, protected altogether for a series of years. A list is given showing the months in which shooting of quails is permitted in States which suffer most from chinch bug. Concerning diseases, Dr. Shimer's contribution to the subject is quoted in part; a short summary from Prof. Forbes's Twelfth Report is given; Prof. Riley's doubt of the practicability of artificially producing these diseases to any successful extent is noted, as also Prof. Forbes's statement that this proposed remedy is still a theoretical one only. The influence of wet weather on the chinch bug is considered at length, the great preponderance of opinion being, it is said, that it is unfavorable, though in just what way is a disputed point. Quotations are given from Walsh, Thomas, Riley, and Forbes, and two meteorological tables are given; the one furnished by Prof. Atkinson bearing upon the influence of temperature and rainfall on chinch bugs in North Carolina in '85, '86, and '87, and that furnished by the Chief Signal Officer showing the precipitation in chinch-bug States for the same years. The opinion is expressed that 1888 will not be a chinch-bug year. Under "Remedies and Preventives" there is a recapitulation of matter contained in Riley's Seventh Report and Thomas's Bulletin No. 5 of the U. S. Entomological Commission; Prof. Osborn's experiments in burning and with kerosene emulsions are given; and reference is made to experiments by Prof. Forbes with the kerosene emulsion, as reported to the Entomological Division and published in its Bulletin No. 2 (1883), and the emulsions, as diluted, are

given. The formula recommended is one originally proposed by H. G. Hubbard, and is as follows:

Kerosene.....	2 gallons....	=67 per cent.
Common soap, or whale-oil soap.....	$\frac{1}{2}$ pound...	} =33 per cent.
Water.....	1 gallon...	

The solution of soap, boiling hot, is to be added to the kerosene, and the mixture churned for five or ten minutes by means of a force-pump and spray-nozzle. One part of this emulsion to nine parts of water is considered strong enough. "Bogus chinch bugs" are described, and figures reproduced from Riley's Seventh Report, and a bibliographical list is given of the most important articles on the chinch bug from 1831 to 1887 inclusive.

PACKARD, A. S.—The Chinch Bug. (Entomology for Beginners, p. 195.)

Brief mention of mode of injury to plants, life history, and remedies.

RILEY, C. V.—Report of the Entomologist. Introduction. (Rept. [U. S.] Commiss. Agric. 1887, p. 48.)

The great damage done by the chinch bug in most of our Western grain-growing States has been the entomological event of the year. The Statistician of the Department of Agriculture reports \$60,000,000 as the very lowest estimate of damage in nine States.

WEBSTER, F. M.—Report on the Season's Observations, and especially upon Corn Insects. (Rept. [U. S.] Commiss. Agric. 1887, p. 151.)

Chinch bugs observed in considerable numbers in March, 1887, in Tensas Parish, La., about young corn, pairing and ovipositing. Said to do considerable injury at times. The only small grain in the locality where they were observed was an occasional field of fall oats or millet.

BRUNER, LAWRENCE.—Report on the Season's Observations in Nebraska. Chinch Bug. (Rept. [U. S.] Commissioner Agric., 1887, p. 165.)

Rumors of chinch-bug depredations were circulating the second week in July, and a week later it was known that their ravages were not confined to Nebraska but extended into Kansas, Missouri, Iowa, portions of Illinois, Minnesota, and Southeastern Dakota. Meteorological conditions were favorable to the most complete development of the bug, comparatively few natural enemies were present, and especially in portions of Nebraska, Iowa, and Kansas there is always great carelessness with regard to rubbish. After the bugs have become a pest the only effectual remedy is wet weather, which induces disease and dissolution. It can be held in check by clean farming, burning rubbish in late fall, winter, or early spring, protection of birds,—especially quails,

—deep plowing immediately after harvest, rolling, ditching, fencing, and the use of insecticides. Ditches into which water can be turned form complete barriers to their creeping migrations, and in regions that depend entirely upon irrigation for moisture, or such as are easily flooded, there need never be loss from this insect. Favorite food plants are mentioned, wild buckwheat being quoted as a delicacy. Weedy or grassy fields of small grain or corn are sometimes relatively little damaged.

PRAIRIE FARMER, May 12, 1888.

Pope Co., Ill., April 21. Chinch bugs and cutworms very numerous.

FARMERS' REVIEW. CROP REPORTS AND F. R. CLUB RECORD.

May 23, 1888. *Bond, Edwards, Jackson, Jasper, and Saline Co's.* General mention of chinch-bug injury except from Saline county, where wheat is said to be poor on account of drouth and chinch bugs. May 30, 1888. *Clark Co.* Winter wheat killed by chinch bugs. *Coles Co.* Small grain will be killed if the year is dry. *Crawford, Wabash, and Wayne Co's.* Chinch bugs doing enormous damage. June 6, 1888. *Christian Co.* Small grain injured. *Wabash Co.* Wheat and some meadows damaged. *Washington Co.* Some chinch bugs. *Wayne Co.* Winter wheat destroyed. June 13, 1888. *Edgar, Effingham, Hamilton, Randolph, and Shelby Co's.* More or less damage from chinch bugs. June 20, 1888. *Clark, Edwards, and Jasper Co's.* More or less damage done by chinch bugs, or expected. *Jefferson Co.* Small grain is being destroyed. *Richland Co.* Winter wheat eaten up. June 27, 1888. *Cumberland, Henry, Lawrence, and Macoupin Co's.* Chinch bugs reported as more or less injurious. *Clinton Co.* Small grain injured. *Franklin Co.* Wheat and oats badly damaged. July 4, 1888. *Coles, Crawford, Shelby, Wabash, and Williamson Co's.* Small grain more or less injured. *DuPage, and Madison Co's.* Chinch bugs present. *Washington Co.* Wheat injured. July 11, 1888. *Calhoun, Edgar, Gallatin, Knox, Pope, and Shelby Co's.* Grain injured more or less. *Hamilton Co.* Wheat almost destroyed. *Livingston Co.* Chinch bugs killed by heavy rain. *Richland Co.* Wheat and corn badly injured. July 18, 1888. *Clark and Edwards Co's.* Grain injured by chinch bugs. *Jackson Co.* Some damage. *Jefferson Co.* Wheat, oats, and timothy injured. July 25, 1888, p. 467. *Franklin Co.* Oats good, but damaged by bugs. Aug. 15, 1888, p. 515. *Edwards Co.* Chinch bugs killing corn. Aug. 22, 1888, p. 531. *Carroll Co.* Spring wheat damaged. *Massac Co.* Corn hurt by bugs and drouth.

IOWA.—June 20, 1888. *Boone Co.* Spring wheat injured. *Iowa Co.* Small grain injured. July 4, 1888. *Warren Co.* Wheat nearly all ruined by chinch bugs last year. July 18, 1888, pp. 451, 458. *Benton, Iowa, and Keokuk Co's.* Grain injured by chinch bugs. *Howard Co.* Barley damaged. Aug. 1, 1888, v. 19, p. 488.

Winneshiek Co. Spring wheat destroyed by bugs. Aug. 15, 1888, p. 515. *Benton, Keokuk, Marion, Muscatine, and Van Buren Co's.* Spring wheat very seriously damaged. Sept. 5, 1888, p. 563. *Chickasaw Co.* Spring wheat nearly ruined.

KANSAS.—July 4, 1888. *Franklin Co.* Bugs are numerous in corn adjoining wheat. July 18, 1888. *Leavenworth Co.* Chinch bugs very bad. Aug. 15, 1888, p. 515. *Stafford Co.* Oats and corn injured.

KENTUCKY.—May 9, 1888. *Crittenden Co.* Much damage from chinch bugs.

MINNESOTA.—July 4, 1888. *Wabasha Co.* Many chinch bugs. Winter wheat damaged. July 18, 1888. *Fillmore Co.* Chinch bugs injuring barley. *Hennepin Co.* Grain somewhat damaged. Aug. 1, 1888, p. 488. *Mower Co.* Bugs have eaten spring wheat. Aug. 8, 1888, p. 499. *Dakota Co.* Chinch bugs destroyed spring wheat. Aug. 15, 1888, p. 515. *Fillmore, Isanti, and Wabasha Co's.* Spring wheat more or less injured.

MISSOURI.—July 18, 1888. *Texas Co.* Wheat nearly destroyed. *St. Genevieve Co.* Damage by chinch bugs. Aug. 1, 1888, p. 488. *Benton Co.* Winter wheat killed by bugs. *St. Charles Co.* Corn damaged seriously.

NEBRASKA.—Aug. 1, 1888, v. 19, p. 488. *Butler Co.* Chinch bugs ruined spring wheat. Aug. 22, 1888, p. 531. *Butler Co.* Spring wheat ruined.

OHIO.—July 18, 1888. *Meigs Co.* Grain injured. Aug. 15, 1888, p. 515. *Madison Co.* First appearance of chinch bugs in wheat this season.

WISCONSIN.—July 18, 1888. *Eau Claire and Chippewa Co's.* Barley destroyed. *Marquette Co.* Grain injured a little. Aug. 1, 1888, p. 488. *Clark and Ontagamie Co's.* Spring wheat injured. Aug. 15, 1888, p. 515. *Calumet Co.* Wheat and barley damaged.

MONTHLY WEATHER REVIEW OF THE ILLINOIS STATE WEATHER SERVICE FOR MAY, 1888. Weather Crop-Bulletin, May 12, p. 9. Season and Condition of Crop[s].

The most discouraging feature of the season is the presence of chinch bugs, army worms, and other insects in unusual numbers in many of the central and southern counties.

FARMERS' REVIEW, May 30, 1888. [Burning corn stalks to get rid of the chinch bug.]

Editor notes a case of "disagreement of doctors." Recent articles lay great stress on burning all litter upon the farm, but Secretary Graham, of the Agricultural College, at Manhattan, Kansas, in "The Industrialist," gives it as his opinion that the burning of corn stalks and weeds to kill chinch bugs is a waste of time, as they do not hide in them, but very close to the roots of the grass. Burning the grass does not reach many of them.

STATISTICAL REPORT ILLINOIS STATE BOARD OF AGRICULTURE FOR
JUNE 1, 1888. Circular No. 140, pp. 4, 12-30.

Much damage to winter wheat by chinch bug is reported for the southern and central portions of the State.

Correspondents' Remarks.—*Bond, Clay, Clinton, Marion, Moultrie, Pope, Richland, and Shelby Co's.* Chinch bugs doing serious damage to wheat; also to corn in Moultrie county and to oats in Shelby.

PRAIRIE FARMER, June 2, 1888. Salt for Chinch Bugs.

A correspondent writing from La Crosse, Wis., says he has used common barrel salt on corn and Hungarian grass with perfect success. He used about two bushels per acre when the bugs first appeared on the crops, sowing it broadcast on the grass and throwing a teaspoonful on each hill of corn.

INDIANA FARMER, June 2, 1888, v. 23, p. 9. Valuable Observations of an Old Farmer.

"The chinch bug has quit breeding in the wheat since I began sowing salt on the fields in April."

HALLOWELL, J. R. — A Plan for Fighting Chinch Bugs. (Farmers' Review, June 27, 1888.)

Take two logs six inches in diameter by four feet in length and place parallel, fastening them together with 2x6 cross pieces. With a one-horse plow run a furrow around field; then place one runner of this drag in furrow, hitch to, and, standing on same, drive to end of furrow. Plow another furrow where the other runner of drag leaves mark. Now run back and forth with drag until the earth is well pulverized. If properly done at right time of day, and before the bugs gain wings, you will destroy them by the millions, the second furrow catching any that may cross the first.

MONTHLY WEATHER REVIEW OF THE ILLINOIS STATE WEATHER SERVICE FOR JUNE, 1888. Weekly Weather Crop-Bulletins, Crop Prospects, pp. 8-11.

June 9. Rain has lessened the danger to wheat and corn from chinch bugs, in the southern counties, but corn is seriously damaged. June 16. Prospects for grain and grass in southern division of State greatly reduced by drouth, army worm, cutworms, and chinch bugs. June 23. Rains have largely reduced the number of chinch bugs. June 30. Wheat harvested in southern counties generally inferior, owing to unfavorable season and injury by chinch bug.

STATISTICAL REPORT ILLINOIS STATE BOARD OF AGRICULTURE FOR
JULY 1, 1888. Circular No. 141, pp. 11-20.

Correspondents' Remarks.—*Alexander, Clinton, Hardin, Moultrie, Saline, and St. Clair Co's.* Chinch bugs going from wheat to corn. *Bond, Clay, Franklin, Gallatin, Johnson, Mason Mas-*

sac, Wayne, White, and Williamson Co's. Chinch bugs in corn. Effingham, Fayette, and Jasper Co's. Some complaint of chinch bugs, but recent rains have checked ravages. Hamilton, Lawrence, and Marion Co's. Chinch bugs in wheat and corn; not much damage. Pope Co. Some complaint of chinch bugs. Shelby Co. Corn adjacent to wheat and rye injured. Wabash Co. Chinch bugs are worse than ever known before.

STATISTICAL REPORT ILLINOIS STATE BOARD OF AGRICULTURE,
July 1, 1888, Circular 141, p. 21. Chinch Bugs.

At a mass meeting of the farmers of Crawford county, called to consider methods of protecting their crops against the chinch bug, after an address by Prof. Forbes on "The Relations of Wheat Culture to the Chinch Bug in Illinois," the following resolutions were adopted:

"Resolved, That we, the farmers of Crawford county, in mass meeting assembled, do hereby promise and agree with each other that we will not raise as crops on our lands in this county any wheat, barley, or rye for the next three years; and that we will use our influence in our neighborhoods, in every way practicable, to prevent the raising of these crops by others.

"Resolved, That we will use every reasonable and safe opportunity to burn over, in fall or spring, all headlands, thickets, and woodlands, and to destroy all waste and rubbish which can afford a winter harborage to the chinch bug.

"Resolved, That we intend to practice and earnestly recommend the heavy fertilization of all ground devoted to crops especially liable to injury by the chinch bug.

"Resolved, That since it has now been proven that under existing conditions all the cultivated grasses may be badly damaged by the chinch bug in spring and early summer, while clover is entirely free from liability to such injury, we urgently advise the sowing of clover for forage instead of the grasses.

"Resolved, That we advise that especial attention be paid during the coming season to such crops as the chinch bug does not attack.

"Resolved, That we suggest, as a most promising and important experiment, the sowing of plots of wheat or rye to be plowed up and killed late in May or early in June, and to be followed with millet or Hungarian—this to be plowed up in turn when well stocked with the eggs and young of the second brood of the chinch bug.

"Measures were also taken to hold similar meetings in the different towns and districts of the county, with a view to making the action general."

FARMERS' REVIEW, July 11, 1888.

From Richland county, Ill., a correspondent writes that the chinch bugs were at work during the dry cold weather from the first of March to the middle of May. Still at work in oats and corn, though recent rains have checked them.

MONTHLY WEATHER REVIEW OF THE ILLINOIS STATE WEATHER
SERVICE FOR JULY, 1888. Weekly Weather Crop-Bulletins,
pp. 9-12. Crop Prospects.

July 7. Chinch bugs are still operating on the wheat. July 14. Complaints of damage to corn from chinch bugs are mainly from southern counties. July 28. The complaints of injury to crops from chinch bugs and other insects have not for many years been so numerous or generally distributed as during present season. In many of the southern counties farmers are holding mass meetings to determine the most practical methods of destroying the chinch bug.

FORBES, S. A.—The Chinch Bug. (Robinson [Ill.] Argus, July 18, 1888; Indiana Farmer, Aug. 4, 1888, p. 9.)

Reporter's abstract of paper entitled "The Relations of Wheat Culture to the Chinch Bug in Illinois," delivered at the mass meeting of the farmers of Crawford county, noted above.

PRAIRIE FARMER, July 21, 1888. Harvest Notes.

From Butler Co., Kansas: "No chinch bugs to do much damage except where the rye fields are cut."

MAHIN, S. T.—Voracious Missouri Bugs. (Prairie Farmer, July 21, 1888, v. 60, p. 469.)

Writing from Pettis county, says that the use of salt on millet, corn, and sorghum, and the sowing of timothy with wheat, as measures against the chinch bug, have failed this year in his county. The bugs like timothy about as well as wheat, and do not object to having their food salted. Much wheat plowed up and planted to corn, but the corn was taken likewise; in some cases a second planting.

PRAIRIE FARMER, July 28, 1888, v. 60, p. 479.

"Chinch bugs are reported in immense numbers in the Miami Valley, Ohio. Recent rains checked their ravages, but the pest is now in oats and corn. * * * Have been no chinch bugs in this vicinity since 1881."

PRAIRIE FARMER, July 28, 1888, v. 60, p. 487. Chinch Bugs in Southern Illinois.

Notice of the mass meeting in Crawford Co., Ill., referred to on previous page, with reprint of resolutions passed. Madison county farmers, at a recent meeting, pledged themselves not to sow wheat or rye, for two years, and to use every available means to destroy the chinch bug.

WEED, CLARENCE M.—The Chinch Bug in Ohio: Midsummer Remedies. (Ohio Agric. Experiment Station, Bull. No. 4, 2d series, July, 1888, pp. 53, 55. (Reprinted in part in Prairie Farmer, July 28 and Sept. 1, 1888.)

The chinch bug is injuriously abundant in certain counties of Ohio, notably Franklin. As remedial measures the following are recommended: the plowing of infested fields as soon as wheat is cut,—for a rod or two along the borders (harrowed occasionally to make the soil friable) if the field cannot be wholly plowed; the burning of stubble in infested fields before the bugs leave, using sometimes a light coating of straw to facilitate the operation; coal-tar as a barrier to migration, applied frequently, having holes for traps at intervals along the line; kerosene emulsion applied when bugs have reached outer rows of corn (formula being given for preparation); and trapping in furrows.

STATISTICAL REPORT ILLINOIS STATE BOARD OF AGRICULTURE,
 AUG. 1, 1888. Circular No. 142, pp. 15-27. Correspondents'
 Remarks.

Alexander, Bond, Clark, Jackson, Jefferson, Johnson, Perry, Pope, Pulaski, Washington, Wayne, and Williamson Co's. Corn more or less damaged. *Clinton, Crawford, DuPage, Fayette, Gallatin, and Hamilton Co's.* Corn adjacent to wheat more or less damaged. *Edwards Co.* Corn injured by drouth and chinch bugs. *Jasper Co.* After wheat harvest, attacked oats, doing considerable damage. *Macoupin Co.* Heavy rains have destroyed the chinch bugs, which have been working on corn since wheat harvest. *Madison Co.* Winter wheat was considerably damaged. *Wabash Co.* Corn on high land injured.

FARMERS' REVIEW, Aug. 1, 1888, v. 19, p. 490. Chinch Bugs there.

A farmer in Ohio writes that finding chinch bugs on his corn about the first of July he applied kerosene emulsion three times and escaped injury by them. Never heard of them there before. Thinks they bred in wheat adjoining the corn.

PRAIRIE FARMER, Aug. 4, 1888, v. 60, p. 507. Weather and Crop Notes.

In the chinch-bug region of Illinois the yield of wheat per acre is as unsatisfactory as its low grade. Complaints of injury from chinch bugs and other insects more numerous and general than for many years.

From Edwards Co., Ill., a correspondent writes that chinch bugs have ruined a great deal of corn, and that meadows are generally poor on account of drouth and bugs last year.

GILLETTE, C. P.—A New Chinch-Bug Enemy. (Prairie Farmer, Aug. 11, 1888.)

A fungoid disease is destroying millions of chinch bugs on the grounds of the Iowa Agricultural Experiment Station. The fungus belongs to the genus *Entomophthora*.

BARNHILL, J. B.—Chinch Bugs in Vermont. (Albion [Ill.] Journal, Aug. 23, 1888. Reprinted from Louisville Ledger.)

About twenty years ago these bugs began to infest farms in this region and ruined a number of crops. Farmers stopped raising wheat, and in two or three years the bugs disappeared.

PATRICK, I. A.—The New Enemy of the Chinch Bug. (Prairie Farmer, Aug. 25, 1888, v. 60, p. 545.)

Writing from Iola, Clay Co., Ill., he says that about July 8 or 10 he observed among the chinch bugs the same disease recently reported by C. P. Gillette. (See under Aug. 11.) They all died, depositing no eggs.

WEED, CLARENCE M.—The Chinch-Bug Scourge. (Prairie Farmer, Aug. 25, 1888, v. 60, p. 545.)

General article urging coöperation by farmers for the destruction of the chinch bug.

FARMERS' REVIEW, Aug. 29, 1888, v. 19, p. 546.

Editors report that a "second crop" of chinch bugs has appeared in the vicinity of Metropolis, Massac county, Ill., and corn is being injured by them. It is recommended that after corn is gathered cattle be at once turned into the stalks, and, later, that the remnant be burned.

FARMERS' REVIEW, Aug. 29, 1888, v. 19, p. 554.

A correspondent from Grant Co., Kan., reports corn much damaged by drouth and chinch bugs. Recommends that no wheat be raised for a few years.

MONTHLY WEATHER REVIEW OF THE ILLINOIS STATE WEATHER SERVICE FOR AUG., 1888. Weekly Weather Crop-Bulletin, p. 7.

Aug. 4. Corn has been seriously damaged in some sections by the chinch bug.

GILLETTE, C. P.—A few Important Chinch-Bug Remedies. (Bull. Iowa Agric. Coll. Experiment Station, No. 2, p. 25. Extracts in Prairie Farmer, Oct. 20, 1888.)

Climatic conditions in Iowa this year have been unfavorable to the chinch bugs, and they have not occurred in injurious numbers except over limited areas. We cannot, however, predict the weather with any certainty, and systematic measures against the pest should be taken. Plowing bugs under to a depth of at least six inches is an effective remedy, and may be resorted to in early summer wherever bugs are first found injurious, usually along the borders of fields or on high sandy spots. When small grain is harvested, stubble should be carefully examined, and if bugs are present in considerable numbers it should be plowed at once. Instances are given illustrating the effectiveness of this treatment. If in spring it seems likely that work will be too pressing to admit of much plowing immediately after harvest, fields of grain should be surrounded with strips of millet, on which the bugs will accumulate when migrating from the grain, a furrow or two being plowed outside the strip and thrown into the field to keep the bugs from passing. When all the bugs seem to have left the stubble the millet may be cut,—saved if worth it,—and the strip plowed, dragged, and thoroughly rolled as quickly as possible. Plowing in fall is effective wherever bugs are numerous; and previous scattering of straw, cornstalks, manure, and the like, tends to secure an accumulation of the insects. In order to gain the most from plowing, the surface of the soil must all be thrown to the bottom of the furrow, which can be done most effectually by the use of a jointer on the plow. Burning is sometimes preferable to plowing, if it can, by any device, be

thoroughly done. Grow those grains and grasses that will put forth the greatest expanse of leaf surface, as this will lower the temperature of the ground and increase the moisture about the roots of the plants, thus creating conditions unfavorable to the development of the bugs. Experiments with different varieties of millet confirm this theory. That the soil may be in a condition to grow vigorous crops, in many cases there must be more manuring and less cropping. Get spring crops in as early as possible, that the ground may be shaded before the young bugs hatch out. Neat farming, allowing no rubbish to accumulate, is an important preventive measure. Kerosene emulsion, coal-tar, gas lime, etc., may be used when they seem, in a given case, likely to be of benefit, but the above-mentioned measures are considered the most practical for farmers generally. Unity of action, whatever the expedient, is essential to the best results.

PRAIRIE FARMER, Sept. 1, 1888, v. 60, p. 566. War on Chinch Bugs.

Farmers are becoming aroused to the necessity of concert of action in combating the chinch bug. Wabash county has organized for attack within the last week, and two more counties are ready for this measure. In Minnesota efforts are being made in the same direction.

PRAIRIE FARMER, Sept. 8, 1888, v. 60, p. 583. Weather and Crop Notes.

Price Co., Wis. Barley damaged by chinch bugs. Corn adjacent to wheat or barley injured. Dwight [Butler Co.], Neb. Spring wheat and corn damaged by chinch bugs.

FORBES, S. A.—Salt for the Chinch Bug. (Farmers' Review, Sept. 12, 1888, v. 19, p. 580.)

Reply to question and a newspaper clipping concerning salt for the chinch bug.

"I have not personally experimented with salt for the chinch bug, the bulk of the evidence concerning this substance being so unfavorable to it that I have not thought it worth while."

PRAIRIE FARMER, Sept. 15, 1888, v. 60, p. 599. Weather and Crop Notes.

"The Missouri Board of Agriculture in a recent report states that 'the danger from chinch bugs has mainly passed away, with only a moderate amount of injury.'"

INDIANA FARMER, Sept. 22, 1888, v. 23, p. 29. The Chinch Bug is here.

Chinch bugs by the thousand on our late sugar cane.

FORBES, S. A.—The Chinch Bug. (An address delivered before a meeting of farmers at Belleville, Ill., Sept. 11, 1888, and reported for the Belleville Weekly Advocate, Sept. 28, 1888.)*

The statistician of the U. S. Department of Agriculture estimates the loss in this State last year due to the chinch bug at about \$12,000,000, a sum large enough to furnish bread to every man, woman, and child in Illinois for an entire year. Recent efforts at coöperation among farmers an encouraging sign, although "the best time for action passed four years ago, when it became evident that a chinch-bug outbreak was impending;" but demonstrate now that you can and will control this pest and you will add at least twenty per cent. to the value of every farm in Southern Illinois. Points in life history are given; mode of hibernation, favorite food plants, those it does not attack, etc. The empty crusts of the last moult are often mistaken for dead chinch bugs. The old hibernating bugs are nearly all dead by the middle of June, and the winged form of the new generation begins to appear about July 1. It is commonly about sixty days after the laying of the egg before the winged insect appears, but as the eggs are laid at intervals during three or four weeks the bugs from the first are several weeks old when the latest laid eggs are hatching. The spring generation makes its way, chiefly on foot, from ripening wheat to oats or corn, the last of the brood getting wings in August. The eggs for the second generation are laid behind the sheaths of the leaves at the base of the corn stalk or in the ground about the roots. Three broods are said to occur in the latitude of North Carolina, and a few possible examples of a third brood have been noticed in Southern Illinois, but, practically, the insect is two-brooded in this State. The varying numbers of the chinch bug are chiefly due to climatic differences. Their bird and insect enemies are insignificant, but they are subject to two fatal contagious diseases, one of them now apparent in Clinton and adjacent counties. "Their enormous numbers under favorable conditions are accounted for by their high rate of multiplication, a single female having the capacity to give origin during a single season, if all things are favorable, to about 90,000 progeny. Two hundred hibernating bugs may therefore produce 18,000,000 during the succeeding summer,—enough, if placed end to end, to make a file [twenty-]eight miles in length." The proper economic procedure is first pointedly intimated by an account of the measures to be employed if one would raise chinch bugs successfully and keep them up to the highest level of multiplication; and the subject is then dealt with directly by giving a practical account of remedial and preventive measures. The hibernating season, the time of attack on wheat in spring, and that of midsummer migration from breeding ground, said to be critical periods in life history of insect. Fire is the means of attack in the first instance, and late in fall or early in spring the torch should be carried to

*This address was also made at Robinson, Crawford Co., at Louisville, Clay Co., and at Mt. Carmel, Wabash Co.

headlands, thickets, borders of woods, etc. Wire fences or a stock law making fences generally needless would facilitate this measure. With regard to the second period we can only prepare for the attack. "We may refrain, as far as possible, from raising the favorite crops of the chinch bug—especially wheat, barley, and rye—with the double advantage of thus subjecting ourselves to little or no immediate injury, and of reducing the numbers of the bugs that infest one's premises later." In regard to wheat, however, the weight of much carefully accumulated evidence goes to show that while this is an indispensable preventive measure, it will not, when bugs are present in large numbers, greatly reduce them, since, not finding wheat or rye, they will breed elsewhere. In Southern Illinois, under existing circumstances, this expedient must not be relied on to the exclusion of more active measures. (3) Raise clover generally as forage plant when chinch-bug injury is imminent, as we have learned here that the grasses cannot then be relied upon for either meadow or pasture. (3) Use every means to increase and maintain the fertility of the soil, especially relying on the direct application of fertilizers to crops attacked or liable to injury. By this means have raised first-class crops of wheat, though ground was "enormously infested" by chinch bugs in the beginning of the season. (4) Clover or flax may be sown on wheat in spring. (5) Sow wheat early as a measure against chinch-bug injury—though this will of course increase the liability to damage by the Hessian fly. (6) Sowing favorite food plants as lures or decoys is advised as an experiment. As bugs fly abroad in spring they will be almost certainly attracted to such growth for the deposition of their eggs, and may be destroyed there, with the young, by deep plowing and rolling, late in May or early in June. Later in the season the same ground might be sowed to millet or Hungarian, and the second generation be destroyed similarly to the first. Next, as to measures suited to the third critical period,—the time of the midsummer migration. (1) The bugs may be almost certainly detained where they originated, or killed as they attempt to escape, by a narrow belt of coal-tar, mixed with ten per cent. of oil or grease, poured into a furrow extending around the field and cleared of loose earth, or placed on a continuous belt of boards. This mixture will need to be renewed once in three or four days, and for five applications along a line of forty rods will cost between \$1.50 and \$2.00. The bugs which accumulate along the belt may be destroyed by hot water, kerosene, or some mechanical method. Fields of corn may be protected against the first and worst invasion by such a barrier on the side next grain fields. (2) Such as enter the corn notwithstanding, may be killed there with kerosene emulsion. According to some experiments made in Iowa the cost of application is about seventy cents per acre. (3) The fertilization of corn in the hill has proven a considerable defence. (4) Early ripening varieties are of advantage, as they mature in advance of injury by the second generation of bugs. "Other measures are a separation of crops liable to attack, plowing under infested

crops,—to be left until after rains and then planted to some late crop,—plowing or burning stubble immediately after harvest, etc.” We must rely on no single measure, but “fight all along the line.” Regards as especially valuable in the presence of an outbreak, burning in fall and spring, the intelligent use of fertilizers, limiting the acreage of crops especially liable to injury, the use of lures, fencing with coal-tar mixture, and the use of the kerosene emulsion on corn when it is invaded from the edge.

SHELTON, E. M.—Experiments with Wheat. (Experiment Station, Kansas State Agric. Coll., Bull. No. 4, Sept. 1888, p. 43.)

Infested wheat plots plowed under to the depth of eight inches May 9 and 10 and *shortly afterwards* harrowed and repeatedly rolled. Notwithstanding this thorough treatment “an enormous brood of young bugs hatched, a large proportion, apparently, reaching the surface and passing directly to the adjacent crops, which received great damage from them.” This brood did the only noticeable damage that occurred on the College farm by chinch bugs, though they were numerous and voracious.

FORBES, S. A.—Note on Chinch-Bug Diseases. (Psyche, Sept.—Oct., 1888, v. 5, p. 110.)

The two diseases that were apparently efficient in suppressing the chinch-bug outbreak of 1882 (described in Rept. State Ent. Ill. 1882) have not since, until this season, been distinctly recognized. Now, however, chinch bugs in Southern Illinois are being rapidly destroyed by them and by a third disease not hitherto recognized, due to a *Botrytis*. One of the first-mentioned diseases is caused by an *Entomophthora*, the other is due to a microbe (*Micrococcus insectorum*, Burrill) principally developed in the alimentary canal, and is freely cultivable by the processes usual in bacterial investigation. Both the *Botrytis* and the *Entomophthora* finally imbed the insect in a white fungus. The former has been much the more abundant and destructive in Illinois, though apparently less so at present than the bacterial form. It seems likely that these diseases will soon suppress an outbreak which, in view of its continuity and destructiveness, probably has no parallel in the history of this insect.

FARMERS' REVIEW, Oct. 3, 1888, v. 19, p. 628. Sure Remedy for the Chinch Bug. (Quoted from Colman's Rural World.)

When you sow wheat in the fall, leave a strip fifteen or twenty feet all around the field, sowing it with millet the following spring. At harvest the bugs will settle in the millet; then early in the morning, while the dew is on, plow them under and drag and roll the ground thoroughly. The following method for corn is equally effective. With an iron rod and cotton cloth make a swab and saturate with coal oil; then set it on fire, and walking between the rows dash the flames alternately on each side about the stalks, near the ground, while the dew is on. “If there is wind, go against it so that the heat may not precede the flame and scare the bugs out of its reach; if it is calm, walk rapidly so that the heat will

not get ahead of you." If the corn is waist high you can go over it several times without injury to the corn, and it will destroy all the bugs.

MARTEN, JOHN.—Chinch-Bug Parasites. (Prairie Farmer, Oct. 6, 1888, v. 60, p. 650.)

Four species of lady bugs, the larva of a lace-wing fly, the many-banded robber, and a small gray spider are mentioned.

S. A. FORBES.—Chinch Bugs. [Abstract of communication to Secretary Mills, of the State Department of Agriculture.] (Prairie Farmer Oct. 6, 1888, v. 60, p. 650; Farmers' Review, Oct. 10, 1888, v. 19, p. 642.)

States that chinch bugs are being rapidly carried away in every place lately visited in Southern Illinois, by one or two diseases, the same as those which heralded the disappearance of the chinch bug in Central Illinois in 1882. One imbeds the body of the dead insect in a white fungus, the number of these "moldy" chinch bugs being so great in some fields that the ground is whitened as if by a flurry of snow. The other disease, recognizable only by experts, but more general and destructive, is a true germ disease, characterized by bacteria in alimentary canal, and has produced a very great diminution in numbers of chinch bugs where it prevails.

PRAIRIE FARMER, Oct. 13, 1888, v. 60, p. 666. The Chinch-Bug Parasite.

Mr. William Riehl, Washington Co., Mo., writes: "Chinch bugs have suffered here from the fungus disease you speak of. I would judge they are badly used up."

FARMERS' REVIEW, Oct. 17, 1888, v. 19, p. 658. The 1888 Wheat Crop.

Wheat was damaged by chinch bugs in Indiana, Illinois, Iowa, Minnesota, Missouri, and Wisconsin.

FORBES, S. A.—Chinch-Bug Diseases. (Farmers' Review, Oct. 31, 1888, v. 19, p. 692.)

Reply to a letter of inquiry from editor. In addition to information given in the article in Psyche on the same subject (see previous entry) the Botrytis and Entomophthora diseases are said to propagate by means of minute dust-like spores (growing on the bodies of the dead insects) which are communicated to healthy bugs through their air tubes or by falling on their bodies. Nothing very positive can be said as to the usefulness of these diseases, but in 1865, in Northern Illinois, a chinch-bug army disappeared with a disorder that may have been identical with one of the fungus diseases lately observed; and in 1882 the bacterial affection noticed this year prevailed generally in the vicinity of Bloomington and Champaign (Ill.), the chinch bugs the following year being reduced to insignificance in those regions. No traces of diseases were found in the *extreme* southern part of the State, and no

reports of their appearance have come from Northern Illinois. Entomological observers report the diseases in Minnesota, Iowa, and Ohio.

LUGGER, OTTO.—Fungi which Kill Insects. (Univ. of Minn., Coll. of Agriculture, Bull. No. 4, p. 37. Abstracts in Farmers' Review, Nov. 14, 1888, p. 721; in Prairie Farmer, Dec. 1, 1888, p. 778, and in Indiana Farmer, Nov. 17, 1888, p. 7.)

Chinch bugs have done immense damage in Minnesota to the various cereals during the last three years, chiefly in the more southern counties. Owing to the dry warm summers of '85, '86, and '87 they have increased steadily, extending westward and northward. In the spring of 1888, many bugs were killed in their winter quarters by cold and wet weather, but large numbers wintered on the slopes of the hills and formed centers of distribution. The weather being generally favorable, the first brood of bugs became quite numerous and destructive on the Experiment Station farm, and the second threatened disaster. Oats, rye, wheat, and some of our grass, were utterly destroyed. To protect the corn all the infested fields were surrounded by a six-inch board fence fitting snugly to the ground, the upper edge being painted from time to time with tar, which prevented the insects from crossing. The famishing armies were trapped in holes drilled in the ground close to the fence. As one hole was filled it was closed and another opened. These holes, being quite deep, were wet, and the chinch bugs within soon became the victims of a fungus disease which spread rapidly to the fields and destroyed thousands, all showing the characteristic white mycelial threads and spores of the disease. The fungus seems a true species of *Entomophthora*. The disease was soon checked by warm dry weather, but by artificially producing favorable conditions it was protracted for a time on a limited scale. Specimens of the diseased bugs were placed in tight-fitting tin boxes and mailed to eighteen places in Southern Minnesota and the contents thrown into infested fields, apparently with good results, but it is not certain that the disease may not have occurred spontaneously. However this may be, the disease has done its work, and it is not likely that the chinch bug will soon be a menace to our farmers.

MARTEN, JOHN.—Early History of the Chinch Bug in Illinois. (Prairie Farmer, Dec. 15, 1888, v. 60, p. 818.)

First published notice of chinch bug in Illinois in *Prairie Farmer* of 1845, which says it was in Tazewell, Will, and other counties in 1840. W. T. Shelby, Esq., of Olney, has lately informed our State Entomologist that it was in Edwards county in 1828.

COMSTOCK, J. H.—[The Chinch Bug.] (Introduction to Entomology, p. 210, fig.)

Short description of the adult with summary of life history and habits. Satisfactory means of preventing ravages yet to be discovered. A few of the common remedial measures mentioned.

FORBES, S. A.—Relation of Wheat Culture to the Chinch Bug. (Proc. 9th Annual Meeting of the Society for the Promotion of Agricultural Science, 1888, pp. 27-33.)

Elaborate discussion of the effect of an increasing acreage of wheat on chinch-bug increase. Data derived from reports of township assessors for 1886-87, and from replies by assessors to circular of inquiry. Separate tabulation and discussion for Southern, Western, Central, Eastern, and Northern Illinois, and for the whole State. General conclusion: the chinch-bug injury increases, broadly speaking, with increase of wheat area. Final conclusions postponed until data have been more thoroughly studied.

ERRATA.

- Page 1, third foot note, for 5 and 6, read 3 and 4.
Page 22, lines 22 and 23, for excessive, read successive; foot-note, for 37 read 23.
Page 29, foot-note, for 13, 19, 22, read 11, 17, 20, respectively.
Page 32, line 9, for 11 read 9.
Page 35, foot-note, for 11 read 9.
Page 36, line 16, for January read June.
Page 47, line 12 from bottom, for bacilus read bacillus.
Page 51, line 22, for *persicarium* read *persicaria*.
Page 54, line 18, for abundant read abandoned.
Page 58, line 1, strike out hyphen.
Page 60, line 6 from bottom, insert comma after *cariosus*.
Page 65, last line long primer, for 46 read 45.
Page 66, lines 1 and 2, after *achreus* strike out interrogation point and "with great misgiving as to its species": line 3, for Phragmites read Scirpus.
Page 72, line 18, for Historie read Histoire; line 24, for Ed. Le Conte read Le Conte's edition.
Page 76, line 14, for circular read semi-circular.
Page 85, for Southern read Central.

INDEX.

A

- æqualis*, *Sphenophorus*, 60.
agrotipennella, *Anaphora*, 98.
Agrotis bicarnea, 87.
 clandestina, 85.
 gladiaria, 89, 90. See under Cutworm, Clay-backed.
 lerilis, 89.
 morrisoniana, IX, 84, 85, 89, 90.
 saucia, 92.
 subgothica, 85, 88, 90.
 vestigialis, 90.
 ypsilon, 85, 93.
 Alfalfa, injury to, by meadow maggots, 79.
 Ambrosia, 51.
 American Entomological Commission, Bulletin, cited, 32.
 Entomologist cited, 32.
 Naturalist cited, 59, 60, 62.
 Philosophical Society, Proceedings, cited, 59, 60, 61, 62, 63.
Anaphora agrotipennella, 98.
Anatis 15-punctata, injury to cherries, XI.
 Ant, White, injuries by, XIII.
 Anthers as food of *Rhynchites hirtus*, 76.
antiqua, *Sphenophorus*, 61.
Aphis maidis, XII.
arcanella, *Pseudanaphora*, X, 98.
arctica, *Hadena*, 97.
 Army Worm, IX.
 Arsenic for Chinch Bug, 41, 56.
 Arsenical poisons for Chinch Bug, 42.
 for Codling Moth, X.
 method of field application, X.
 Atkinson, Geo. F., 37.
 on kerosene emulsion for the Chinch Bug, 38.

B

- Bacteria, 45, 46.
 Bacterial disease of chinch bug, 45, 46, 56.
Balaninus uniformis, food of, 77.
 Beetles, injury to, by *Sphenophorus parvulus*, 63.
 Bartley, Samuel, 35.
 on ditching as measure against Chinch Bug, 53.
 on kerosene emulsion for the Chinch Bug, 39.

- Bean, injury to, by Clay-backed Cutworm, 91, 92.
 by cutworms, 84.
 by Dingy Cutworm, 88.
bicarnea, *Agrotis*, 87.
bicolor, *Rhynchites*, 75.
bicornis, *Tipula*, 78, 79, 80, 81.
Bidens, 51.
 Bill Bug, Clay-colored, 59, 69.
 Bill bugs, 58.
 Birds as enemies of *Sphenophorus*, 71, 72.
 Black-throated Bunting feeding on *Sphenophorus*, 71.
blanda, *Systema*, XI.
Blissus leucopterus, 1. See Chinch Bug.
 Blister beetles, effect of steam upon, 43.
 Blue Grass, 54, 76, 79, 83, 96.
 injury to, by meadow maggots, 79, 83.
 Bolin, J. O., on meadow maggots, 83.
 Borer, Plum, IX.
 Boston Society of Natural History, Proceedings, cited, 89.
Botrytis, parasite of Chinch Bug, 46, 48, 49, 56.
Braconidæ, parasites of Greasy Cutworm, 93.
 Bristly Cutworm, 95.
 Bristow, Dr., on kerosene emulsion for the Chinch Bug, 38.
 Bronzed Cutworm, 85.
 Brown Thrush feeding on *Sphenophorus*, 71.
 Bruner, Lawrence, Report on the Season's Observations in Nebraska cited, 50.
brunnea, *Parandra*, 49.
 Buckwheat, Wild, infested by Chinch Bug, 50, 56.
 Buhach for Chinch Bug, 42, 56.
 Bulletin of the American Entomological Commission cited, 32.
 Illinois State Entomologist's Office cited, X, 34.
 Illinois State Laboratory of Natural History cited, 71.
 Iowa Agricultural College cited, 38.
 Kansas Agricultural Experiment Station cited, 45.
 U. S. Department of Agriculture cited, 33.
 Department of Agriculture, Division of Entomology cited, 37.
 Geological Survey cited, 89.
 Bunsen, George C., on steam for Chinch Bug, 42.

- Burning for Chinch Bug, 53.
 for *Sphenophorus*, 72.
 stubble for *Sphenophorus robustus*, 71.
 sculptilis, 62.
 Burrowing Web Worm, IX, 98.
 description of imago, 100.
 description of larva, 99.
 injury to Corn, 98.

C

- Cabbage, injury to, by meadow maggots, 79.
 by Spotted Cutworm, 86.
 Worm, European, IX
Cænogenes mortipennella, X, 101.
Cactophagus, 59.
Calandridæ, 58.
callosus, *Sphenophorus*, 60.
 Canadian Entomologist cited, 60, 62, 98, 101.
 carious, *Sphenophorus*, 58, 60, 64, 67, 68, 71.
 Carter, Joseph, on *Sphenophorus placidus*, 71.
 Catbird feeding on *Sphenophorus*, 71.
 Cat-tail, food plant of *Sphenophorus pertinax*, 60.
 Cherries, injury to, by Lady Bug, XI.
 Chester, E. E., on sowing timothy with wheat
 as protection against Chinch Bug, 52.
 Chickens feeding on *Sphenophorus*, 71.
 Chinch Bug, IX, X, XII.
 barriers to migration of, 43, 56.
 coal-tar, 43, 56.
 and oil, 43, 56.
 breeding in Oats, 51, 54.
 contagious diseases of, 2, 40, 45, 56.
 early occurrence of, in Illinois, 50.
 effect of, on grain and corn, 50.
 effect upon, of abandoning corn as a crop, 5.
 of the abandonment of wheat culture,
 6, 55.
 of the successive abandonment of corn
 and wheat, 6.
 food experiments with, 50.
 influence of excessive drouth upon, 5.
 injury, collection of data concerning, 8.
 comparison of the crops for 1886 and
 1887 with reference to, 21.
 experiments with fertilizers to support
 crop against, 35.
 general remarks upon the tables exhibit-
 ing degree of, 10.
 relations of the area of wheat and other
 crops to, 7.
 study of data concerning, 9.
 to all crops combined, compared with
 average of each, 22-32.
 to corn as compared with acreage in
 wheat and other grains, 11-16.
 to grass as compared with areas in wheat
 and other crops, 16-18.
 to meadow, 51.
 to small grain, corn, and grass, reported
 by townships, 1887, 3, 4.
 as compared with the area in wheat
 and other crops, 19-21.

- Chinch Bug, miscellaneous notes and observa-
 tions upon, 50.
 Negro Bug associated with the, 51, 57.
 oviposition of, in midsummer, 51.
 precaution in burning out, in spring, 53.
 secondary effects upon, of the abandonment
 of wheat, 6.
 sowing timothy with wheat as protection
 against, 52.
 starvation experiments, 45, 56.
 studies on the, 1-57.
 summary and conclusions, 53.
 successful defence of corn against, 53.
 summary of current opinion respecting
 wheat culture and the, 32.
 Chocolate-striped Cutworm, description of larva,
 87.
cicatricosus, *Sphenophorus*, 60.
 Cincinnati Society of Natural History, Journal,
 cited, 59.
clandestina, *Agrotis*, 85.
 Clay-backed Cutworm, IX, 85, 89. See Cutworm,
 Clay-backed.
 -colored Bill Bug, 59, 69.
 Clover, injury to, by Clay-backed Cutworm, 90,
 91, 92.
 by Dingy Cutworm, 88.
 by meadow maggots, 75, 82.
 by tipulid larva, XI.
 White, injury to by Western Striped Cut-
 worm, 89.
 Club Rush as food plant of *Sphenophorus*
ochreus, 58, 66, 69.
 Coal-tar as barrier to migration of Chinch Bug,
 43, 56.
 and oil or grease as barrier to migration of
 Chinch Bug, 43, 56.
 emulsion for Chinch Bug, 41, 56.
 water, effect on corn, 40.
 for Chinch Bug, 40, 56.
 Codling Moth, spraying apple-trees to protect
 fruit from, X.
 Coleoptera of North America, check lists, cited,
 59.
Coleus, effect of steam upon, 43.
communis, *Phragmites*, 58.
 Comstock, J. H., on *Sphenophorus pertinax*, 60.
 robustus, 60.
 sculptilis, 61, 62.
concauus, *Lixus*, 76.
Conotrachelus nenuphar, feeding habits of, 76.
 Contagious disease of Chinch Bug, 2, 40, 45, 56.
Corimelæna pulicaria, 51.
 Corn, 54.
 as food of *Tenebrioides mauritanica*, XI.
 Bill Bugs, 58-74. See under *Sphenophorus*.
 frenching of, 62.
 injury to, by Burrowing Web Worm, X, 98,
 100.
 by Chinch Bug, 3, 4, 11-16.
 by Clay-backed Cutworm, 84, 90, 91, 92.
 by cutworms, 84.
 by Dingy Cutworm, 88.
 by Greasy Cutworm, 85, 93.

Corn, injury to—*Continued.*

- by Yellow-headed Cutworm, 97.
- by Glassy Cutworm, 96.
- by Root or Grass Web Worms, IX.
- by *Sphenophorus*, 58-63.
 - cariosus*, 60, 71.
 - ochreus*, XII, 53, 70.
 - parvulus*, 63.
 - pertinax*, 60.
 - placidus*, 62, 71.
 - robustus*, 60, 69, 71.
 - sculptilis*, 61, 62.

plant, effect of steam upon, 42.
of tar water upon, 40.

Root Louse, XII.

successful defence of, against Chinch Bug, 53.

Correspondents, Agricultural, on Cutworms, 91.

Corrosive sublimate for Chinch Bug, 42, 56.

Corson, George, 36.

costipennis, *Sphenophorus*, 64, 67, 68.

Crambus exsiccatus, IX.

fuscicostellus, IX.

zeellus, IX.

Crane-flies, 78.

crus-galli, *Panicum*, 52.

Cultivator, The, cited, 61.

and Country Gentleman cited, 62.

Curculio, Plum, experiment to determine feeding habit, 76.

Cutworm, Bristly, 95.

description of larva, 96.

Bronzed, 85.

Chocolate-striped, description of larva, 87.

Clay-backed, IX, 85, 89.

description of larva, 92.

disease of, 91.

habits and life history, 90.

injury to Beans, 84, 91.

to Clover, 90, 91.

to Corn, 84, 90, 91.

to Onions, 84.

to Strawberry, 84.

to Sweet Potato, 84, 91.

literature, 89.

parasites, 93.

Dingy, description of larva, 88.

injuries to Beans, Clover, Corn, Meadows, Strawberries, Sweet Potatoes, and Wheat, 88.

Glassy, 96.

injury to Corn, 96.

Greasy, injury to Corn, 85, 93.

parasites of, 93.

Pink-backed, 94.

description of larva, 95.

Spotted, number of broods, and food plants, 86, 87.

Variegated, 93.

injury to Sweet Potatoes and Tomatoes, 94.

description of larva, 94.

Western Striped, found on leaves of White

Cutworm—*Continued.*

Clover and Water-melon and on roots of Clover, 89.

W-marked, description of larva, 85.

Yellow-headed, description of larva and mention of injury to Corn, 97.

Cutworms, IX.

Agricultural Correspondents on, 91.

injury to Beans, Corn, Musk-melon, Oats, Onions, Potato, Strawberry, Sweet Potato, and Water-melon, 84.

Notes on, 84-97.

Cyperus strigosus as food plant of *Sphenophorus cariosus*, 68.

D

devastatrix, *Hadena*, 96.

differentialis, *Pezotettix*, XIII.

Dingy Cutworm, 88. See Cutworm, Dingy.

Diseases of Chinch Bug, bacterial, 45, 46, 56.

cultures from, 47, 56.

contagious, 2, 40, 45, 56.

entomophthorous, 48, 56.

culture experiments, 56.

items concerning distribution and activity of, 46, 49.

weather favorable or unfavorable to, 49.

of Clay backed Cutworm, 91.

of European Cabbage Worm, IX.

Ditching as measure against Chinch Bug, 53, 56.

Dodge, J. R., computation of loss by Chinch Bug in Illinois in 1887, 1.

Duffy, Wm. M., on meadow maggots, 83.

dumetorum, *Polygonum*, 50, 56.

Dury, Charles, paper, cited, 59.

E

Egyptian insecticide for Chinch Bug, 42, 56.

Empusa parasitic in body of Chinch Bug, 45, 46.

Entomophthora parasitic in body of Chinch Bug, 45, 48, 49, 56.

Epicærus imbricatus, food of, 76.

Epicauta, effect of steam upon, 43.

European Cabbage Worm, IX.

Euzophora semifuneralis, IX.

exsiccatus, *Crambus*, IX.

F

Farmers' Review cited, 32, 33, 91.

femur-rubrum, *Pezotettix*, XII.

Fernald, C. H., on *Cænogenes mortipennella*, 101.

Fertilization as measure against Chinch Bug, 35, 39, 55, 60.

Fertilizers, 35, 39, 55, 60.

Field Sparrow feeding on *Sphenophorus*, 71.

Fitch, Asa, on *Sphenophorus sculptilis*, 61.

on wheat culture and the Chinch Bug, 32.

Report as State Entomologist of New York cited, 32.

flavipes, *Termes*, XIII.

Flax, 58.

raising, as measure against *Sphenophorus ochreus*, 71.

Flea Beetle, Pale Striped, XI.

Negro Bug, XII, 51, 57.
 flexuosus, Sphenophorus, 60.
 fluviatilis, Scirpus, 58, 66, 68, 69. [See Errata.]
 Forage plants, 79.
 Forbes, S. A., Bulletin of the Office of the State
 Entomologist of Illinois, cited, X, 34.
 circular on the Chinch Bug, cited, 34.
 on kerosene emulsion for the Chinch Bug,
 37.
 on meadow maggots, 79.
 on wheat culture and the Chinch Bug, 33.
 on Sphenophorus ochreus, 58.
 parvulus, 63.
 Report as State Entomologist of Illinois.
 See under Report.
 Foxtail Grass as food plant of Sphenophorus
 ochreus, 70.
 Frenching of corn, 62.
 Fumago as food of Balaninus uniformis, 77.
 Fungi, parasitic, 40, 45, 77.
 fuscicostellus, Crambus, IX.

G

Gas-lime for Chinch Bug, 41, 56.
 water for Chinch Bug, 41.
 Geddes, Gamble, on Sphenophorus sculptilis, 61.
 Germar, E. F., 60.
 gladiaria, Agrotis, 89, 90.
 Glassy Cutworm, 96. See Cutworm, Glassy.
 Glover, Townend, on injury by Corn Bill Bugs,
 59.
 on injury by Sphenophorus cariosus, 60.
 on meadow maggots, 78.
 on Sphenophorus, 71.
 cariosus, 71.
 Grain, small, injury to, by Sphenophorus par-
 vulus, 69.
 stored, injury to, by Tenebrioides mauri-
 tanica, XI.
 Grass, Blue, 76, 79, 83, 96.
 Foxtail, as, food plant of Sphenophorus
 ochreus, 70.
 Hungarian, eggs of Chinch Bugs on roots
 of, 52.
 injury to, by Burrowing Web Worm, 100.
 by Chinch Bug, 3, 4, 16-18.
 by Chocolate-striped Cutworm, 88.
 by Clay-backed Cutworm, 90, 91.
 by Epicærus imbricatus, 76.
 by Meadow Maggots, 78, 79, 82.
 by Sphenophorus parvulus, 69.
 sculptilis, 61.
 Pigeon, 76.
 Web Worms, IX.
 Grasshoppers, X, XII.
 effect of steam upon, 48.
 eggs of, eaten by Spotted Cutworm, 87.
 injury to meadows and orchard, XII.
 to wheat, X.
 Greasy Cutworm, 93. See Cutworm, Greasy.
 injury to Corn, 85, 93.

Grote, A. R., Check List of North American
 Moths cited, 90.
 on Clay-backed Cutworm, 89, 90.
 Guano for Sphenophorus pertinax, 61.
 Gyllenhal, L., 60, 63.

H

Hadena arctica, description of larva, and men-
 tion of injury to corn, 97.
 devastatrix, 96.
 Hagen, H. A., on Tipula bicornis, 80.
 Hamilton, John, on Sphenophorus pertinax, 60.
 placidus, 62.
 Hand-picking for Sphenophorus sculptilis, 61.
 Harrington, W. H., paper, cited, 59.
 Harris, T. W., Insects Injurious to Vegetation,
 cited, 78.
 Hart, C. A., Key to Illinois Species of Sphe-
 nophorus, 63.
 Helianthus as food plant of Lixus concavus, 76.
 of Spotted Cutworm, 87.
 Helms, Frederick, on burning for Chinch Bug,
 58.
 herilis, Agrotis, 89.
 Hessian Fly, IX, X, 54.
 effect of drouth upon, X.
 in experimental sowings, X.
 hirtus, Rhynchites, 75.
 Horn, G. H., paper, cited, 59, 60, 61, 62, 63. See
 LeConte and Horn.
 Howard, L. O., on Sphenophorus robustus, 69.
 on wheat culture and the Chinch Bug, 33.
 Bulletin on the Chinch Bug, cited, 37.
 Hubbard and Schwarz, paper, cited, 59.
 Hultgren, F., on kerosene emulsion for the
 Chinch Bug, 38.
 Hungarian Grass, eggs of Chinch Bugs on roots
 of, 52.
 Hunt, T. F., paper, cited, 60, 62, 63.

I

Illinois, Bulletin of the Office of the State En-
 tomologist of, cited, X, 34.
 State Entomologist of, Reports, cited, 1, 32,
 37, 45, 61, 78.
 Horticultural Society, Transactions,
 cited, 38.
 State Laboratory of Natural History.
 Bulletin, cited, 71.
 imbricatus, Epicærus, 76.
 Insecticides: arsenic, 41, 56.
 arsenical poisons, X, 42, 76.
 buhach, 42, 56.
 coal-tar emulsion, 41, 56.
 water, 40, 56.
 with oil or grease, 56.
 corrosive sublimate, 42, 56.
 Egyptian insecticide, 42, 56.
 gas-lime, 41, 56.
 water, 41.
 guano, 60.
 kerosene, 89.

Insecticides: kerosene—*Continued.*

- emulsion, XI, 37, 40, 55.
- mixed with fertilizers, 39.
- with sand, 62.
- land plaster, 60.
- lime, 61.
- lime water, 41, 56.
- lobelia water, 40, 56.
- London purple, 42, 56, 72.
- Paris green, 42, 56, 72.
- poisons, arsenical, 42, 76.
- quicklime, 60.
- steam, 42, 43, 56.
- tobacco water, 39, 56.
- turpentine emulsion, 41, 56.
- integrifolium, Silphium, 75.
- interstitialis, Sphenophorus, 60.
- Iowa Agricultural College, Bulletin, cited, 33.
- Iris versicolor, as food plant of Mononychus vulpeculus, 77.

J

- Johnson, B. F., on Sphenophorus cariosus, 71.
- Journal of the Cincinnati Society of Natural History cited, 59.

K

- Kansas Academy of Science, Transactions, cited, 59.
- Agricultural Experiment Station, Bulletin, cited, 45.
- Kellicott, D. S., on Sphenophorus costipennis, 68.
- pertinax, 60, 68.
- Kelly, J. A., on sowing timothy with wheat as protection against Chinch Bug, 52.
- Kerosene emulsion for Chinch Bug, 37, 40, 55.
- for White Grub, XI, 40, 55.
- mixed with fertilizers, as measure against Chinch Bug, 39.
- with sand, for Sphenophorus sculptilis, 62.

L

- lacustris, Scirpus, 68.
- lanceolata, Plantago, 51.
- Land plaster for Sphenophorus pertinax, 60.
- larvalis, Sphenophorus, 60.
- latifolia, Typha, 60.
- Lawns, injury to, by Root Web Worms, IX, XI.
- Leather Jackets, 78-83.
- LeBaron, Wm., on wheat culture and the Chinch Bug, 32.
- LeConte, J. L., papers, cited, 59, 60, 61.
- LeConte and Horn, Classification of North American Coleoptera cited, 59, 63.
- leucopterus, Blaesius, 1. See Chinch Bug.
- Light-traps for White Grub, XI.
- Lime for Sphenophorus sculptilis, 61.
- Lime water for Chinch Bug, 41, 56.
- Lintner, J. A., on Sphenophorus sculptilis, 61, 62.

- Lintner, J. A., Report as State Entomologist of New York, cited, 59, 62, 70, 75, 78.
- Lixus concavus, food of, 76.
- terminalis, 76.
- Lobelia as food plant of Spotted Cutworm, 87.
- water for Chinch Bug, 40, 56.
- London purple for Chinch Bug, 42, 56.
- for Sphenophorus, 72.
- Lugger, Otto, 49.
- on Sphenophorus sculptilis, 62.

M

- McMurray, Andrew, 36, 51.
- McNeely, A. J., on Clay-backed Cutworm, 90.
- maidis, Aphis, XII.
- Mamestra meditata, description of larva, 94.
- renigera, 95.
- description of larva, 96.
- Maple plant lice, effect of steam upon, 43.
- Marten, John, 48, 52.
- observation on Parandra brunnea, 49.
- mauritanica, Tenebrioides, XI.
- Meadow Maggots or Leather Jackets, The, 78-83.
- description, 80.
- food experiments with, 82.
- injury to meadows, 78, 79, 82.
- life history and injuries, 81.
- literature, 78.
- remedies, 83.
- worms, 78.
- Meadows, XI.
- injury to, by Chinch Bug, 51, 54.
- by Dingy Cutworm, 88.
- by grasshoppers, XII.
- by root web worms, IX.
- by meadow maggots, 78, 79, 82.
- meditata, Mamestra, 94.
- melanocephalus, Sphenophorus, 64.
- Melon, injury to, by Pale Striped Flea Beetle, XI.
- Metamasius, 59.
- Meteoros, parasite of Clay-backed Cutworm, 93.
- Millet, injury to, by snout beetles, 58.
- by Sphenophorus ochreus, XII, 58.
- minimus, Sphenophorus, 65.
- Miscellaneous Essays on Economic Entomology cited, 1.
- Missouri, State Entomologist of, Report, cited, 32, 61, 78.
- Mononychus vulpeculus, food of, 77.
- Morrison, H. K., on Clay-backed Cutworm, 89, 90.
- morrisoniana, Agrotis, IX, 84, 85, 89, 90.
- mortipennella, Cænogenes, X, 101.
- Murtfeldt, M. E., on Anaphora agrotipennella, 98.
- Musk-melon as food plant of cutworms, 84.

N

- Natural enemies of Sphenophorus, 71.
- Negro Bug, harmlessness and uselessness of, as associated with Chinch Bug, 51, 57.
- Nelson, Elijah, 50.
- nenuphar, Conotrachelus, 76.
- Nephelodes violans, 85.

- New York Agricultural Society, Report, cited, 61.
 State Entomologist of, Reports, cited, 32, 59, 62, 70, 75, 78.
 Notes on Cutworms, 84-97.

O

- Oats, Chinch Bugs breeding in, 51, 54.
 injury to, by Clay-backed Cutworm, 90, 92.
 by cutworms, 84.
 by snout beetles, 58, 63.
 by *Sphenophorus parvulus*, 63.
 young, effect of coal-tar emulsion upon, 41.
 Observations of the Food of the Snout Beetles, 75.
ochreus, *Sphenophorus*, 58, 59, 63, 66, 67, 68, 69, 71.
 Olivier, A. G., *Entomologie, ou Histoire Naturelle des Insectes*, cited, 60.
 Onion as food plant of cutworms, 84.
 Orchard, injury to, by grasshoppers, XII.
 Osborn, Herbert, on kerosene emulsion for the Chinch Bug, 37.
 on wheat culture and the Chinch Bug, 33.
 The Chinch Bug in Iowa, bulletin on, cited, 33.
 Ottawa Field-Naturalists' Club, Transactions, cited, 59.
 Over, William, on disease of Chinch Bug, 48.

P

- Packard, A. S., *Guide to the Study of Insects*, cited, 78.
 paper, cited, 61.
 Pale Striped Flea Beetle, XI.
Panicum crus-galli, chinch bugs' eggs upon roots of, 52.
Parandra brunnea parasitized by *Botrytis*, 49.
 Parasites of Clay-backed Cutworm, 93.
 of European Cabbage Worm, IX.
 of Greasy Cutworm, 93.
 Parasitic fungi, 40, 45, 77.
 Paris green for Chinch Bug, 42, 56.
 for *Sphenophorus*, 72.
parvulus, *Sphenophorus*, 58, 59, 63, 65, 67, 69, 71.
 Pear as food plant of *Epicærus imbricatus*, 76.
pennsylvanicum, *Polygonum*, 76.
persicaria, *Polygonum*, 51.
pertinax, *Sphenophorus*, 58, 60, 64, 67, 68.
 Peyton, R. S., on kerosene emulsion for the Chinch Bug, 39.
Pezotettix differentialis, XII.
 femur-rubrum, XII.
 Philadelphia Academy of Natural Sciences, Proceedings, cited, 60, 61, 90, 100.
 Phragmites. Erratum. See *Scirpus communis* as food plant of *Sphenophorus ochreus*, 58, 69.
Pieris rapæ, IX.
 Pigeon Grass, 76.
 Pink-backed Cutworm, 94.
 description of larva, 95.
placidus, *Sphenophorus*, 58, 62, 65, 67, 68, 70.

- Plant lice, maple, effect of steam upon, 43.
Plantago lanceolata, 51.
 Plantain, 51.
 Plaster, land, for *Sphenophorus pertinax*, 60.
 Plowing under as measure against Chinch Bug, 45, 62.
 Plum as food plant of *Plum Curculio*, 76.
 Borer, IX.
 Curculio, food experiments with, 76.
 Poisons. See under insecticides.
 arsenical, for Codling Moth, X.
 for *Plum Curculio*, 76.
 method of field application, X.
 Pollen as food of *Rhynchites hirtus*, 75.
Polygonum infested by Chinch Bug, 50.
 dumetorum, chinch bugs confined with plant of, 50, 56.
 pennsylvanicum as food plant of *Lixus terminalis*, 76.
 persicaria as food plant of Negro Bug, 51.
 Popenoe, E. A., article on The Chinch Bug and the Season cited, 45.
 paper, cited, 59.
 Potato, injury to, by Clay-backed Cutworm, 91, 92.
 by cutworms, 84, 85.
 Sweet. See under Sweet Potato.
 Practical Entomologist cited, 61.
 Prairie Farmer cited, 32, 33, 45, 61, 78, 79.
 Proceedings of the American Philosophical Society cited, 59, 60, 61, 62, 63.
 Boston Society of Natural History cited, 89.
 Philadelphia Academy of Natural Sciences cited, 60, 61, 90, 100.
Pseudanaphora arcanela, X, 98.
pulicaria, *Corimelena*, 51.
pulicarius, *Thyreocoris*, 51.
pyrrhopus, *Rhinoncus*, 77.

Q

- Quicklime for *Sphenophorus pertinax*, 60.
15-punctata, *Anatis*, XI.

R

- Ragweed, 51.
rapæ, *Pieris*, IX.
 Reed, food plant of *Sphenophorus ochreus*, 58.
 Remedies and preventives for insect depredations: arsenic, 41, 56.
 arsenical poisons, X, 42, 76.
 buhach, 42, 56.
 burning, 53, 72.
 stubble, 62, 71.
 coal-tar as barrier, 43, 56.
 and oil or grease as barrier, 43, 56.
 emulsion, 41, 56.
 water, 40, 56.
 corrosive sublimate, 42, 56.
 cultivating swamp land, 72.
 ditching, 53, 56.
 Egyptian insecticide, 42, 56.
 fertilizers, 35, 39, 55, 60.
 flax-raising, 71.

Remedies and preventives—*Continued.*

- gas-lime, 41, 56.
- water, 41.
- guano, 60.
- hand-picking, 61.
- kerosene, 39.
- emulsion, 37, 40, 55.
- mixed with fertilizers, 39.
- with sand, 62.
- land plaster, 60.
- light-traps, XI.
- lime, 61.
- water, 41, 56.
- lobelia water, 40, 56.
- London purple, 42, 56, 72.
- Paris green, 42, 56, 72.
- plowing under, 45, 62.
- poisons, arsenical, X, 42, 76.
- quicklime, 60.
- sowing timothy with wheat, 52.
- spraying trees, X.
- starvation, 44, 56.
- steam, 42, 43, 56.
- tobacco water, 39, 56.
- trampling by sheep or pigs, 83.
- turpentine emulsion, 41, 56.
- renigera*, Mamestra, 95.
- Reports of the Entomologist to the U. S. Department of Agriculture cited, 62, 70, 75, 78.
- New York Agricultural Society cited, 61.
- State Entomologist of Illinois cited, 1, 32, 37, 45, 61, 78.
- of Missouri cited, 32, 61, 78.
- of New York cited, 32, 59, 62, 70, 75, 78.
- U. S. Commissioner of Agriculture cited, 1, 50, 59, 60, 61, 62, 65, 75, 78.
- of Patents cited, 59.
- Rhinoncus pyrrhopus*, food of, 77.
- Rhodabæus*, 59.
- Rhynchites bicolor*, food of, 75.
- hirtus*, food of, 75.
- Rhynchophora*, food of, 75.
- Riley, C. V., Index to the Nine Reports on the Insects of Missouri cited, 62.
- on Clay-backed Cutworm, 89, 90.
- on larvæ of Tipulidæ, 78, 79.
- on *Sphenophorus parvulus*, 63.
- perlinax*, 60.
- robustus*, 60.
- description, cited, 65.
- sculptilis, 61, 62.
- on wheat culture and the Chinch Bug, 32.
- paper, cited, 59.
- Reports as Entomologist to the U. S. Department of Agriculture cited, 62.
- as State Entomologist of Missouri cited, 32, 61, 78. See also Walsh and Riley.
- Robb, E. H., on meadow maggots, 83.
- Robison, J. W., on Chinch Bug, 7.
- robustus*, *Sphenophorus*, 58, 59, 60, 64, 65, 66, 67, 68, 69, 71.
- Root Louse, Corn, XII.
- Web Worms, injury to lawns and meadows by, IX.

Rose as food plant of *Rhynchites bicolor*, 75.

Rosin weed, 75.

Rural New Yorker cited, 61.

Rye, injury to, by Hessian Fly, 54.

by snout beetles, 58.

by *Sphenophorus parvulus*, 63.

S

saucia, *Agrotis*, 93.

Say, Thomas, Descriptions of New Species of

Curculionites of North America cited, 60, 62.

sayi, *Sphenophorus*, 65.

Schönherr, C. J., Genera et Species Curculionidum cited, 59, 63.

Schwarz, E. A., paper, cited, 59.

Scirpus fluviatilis as food plant of *Sphenophorus ochreus*, 58, 66, 68, 69. [See Errata.]

lacustris as food plant of *Sphenophorus costipennis*, 68.

scoparius, *Sphenophorus*, 58, 62, 64, 68, 70.

sculptilis, *Sphenophorus*, 58, 61, 64, 67, 68, 71, 72.

semifuneralis, *Euzophera*, IX.

Setaria as food plant of *Epicærus imbricatus*, 76.

of *Sphenophorus ochreus*, 70.

Shelby, W. T., on early occurrence of Chinch Bug in Illinois, 50.

Shelton, E. M., on plowing Chinch Bug under, 45.

Sidway, G. D., on kerosene emulsion for the Chinch Bug, 38.

L. B., on kerosene emulsion for the Chinch Bug, 38.

Silphium integrifolium, as food plant of *Rhynchites hirtus*, 75.

Small Grain as food of meadow maggots, 79.

injury to, by Chinch Bug, 3, 4, 19-21.

Smartweed as food plant of Negro Bug, 51.

Smith, John B., 90.

Snout beetles, 58.

frenching of corn by, 62.

Observations of the Food of the, 75-77.

Snow, F. H., paper, cited, 59.

Sowing timothy with wheat as measure against Chinch Bug, 52.

Spanish Needle, 51.

Sphæreacei, 77.

Sphenophorus, 58, 63, 75.

analysis of literature, 59.

birds as enemies of, 71, 72.

description of the genus, 63.

distribution, 67.

economic bibliography, 72.

immature stages, 65.

injuries to vegetation, 69.

to Corn, 59.

key to Illinois species, 63.

life histories, 67.

natural enemies, 71.

remedies, 71.

Sphenophorus equalis, 60.

antiqua, 61.

callosus, 60.

cariosus, 58, 60, 64, 67, 63, 71.

Sphenophorus cariosus, injury to Corn, 60.

cicatricosus, 60.

costipennis, 64, 67, 68.

flexuosus, 60.

interstitialis, 60.

larvalis, 60.

melanocephalus, 64.

minimus, 65.

description, 65.

ochreus, 58, 59, 63, 66, 67, 68, 69, 71.

injury to Corn, 58, 70.

to Millet, 59, 66, 70.

larva, description, 66.

remedies, 71.

parvulus, 58, 59, 63, 65, 67, 69, 71.

injury to Corn, Timothy, Wheat, Barley,
Oats, and Rye, 63.

larva, description, 67.

pertinax, 58, 60, 64, 67, 68.

injury to Corn, 60, 68.

placidus, 58, 62, 65, 67, 68, 70.

injury to Corn, 63, 71.

robustus, 58, 59, 60, 64, 65, 66, 67, 68, 69, 71.

injury to corn, 59, 60, 69, 71.

remedies for, 71.

saxi, 65.

scoparius, 58, 62, 64, 68, 70.

sculptilis, 58, 61, 64, 67, 68, 71, 72.

injury to Corn, 71.

venatus, 61.

zece, 61.

Spotted Cutworm, 86.

number of broods and food plants, 86.

Spraying trees as measure against Codling Moth, X.**Starvation as measure against Chinch Bug**, 44, 56.**Steam**, effect on blister beetles, 43.

on Chinch Bug, 42.

on corn plants, 42.

on grasshoppers, 43.

on Maple Plant Louse, 43.

Strawberry, injury to, by cutworms, 84.

by Dingy Cutworm, 88.

by Thrips tritici, IX.

strigosus, Cyperus, 68.**Strong**, Geo., on meadow maggots, 83.**subgothica**, Agrotis, 85, 88, 90.**Sunflower**, wild, as food plant of *Lixus concavus*, 76.**Sweet**, C. L., on meadow maggots, 82.**Sweet Potato**, injury to, by Clay-backed Cutworm, 91, 92.

by cutworms, 84.

by Dingy Cutworm, 88.

by Variegated Cutworm, 94.

Systema blanda as a melon insect, XI.**T****Tachina**, parasite of Greasy Cutworm, 93.**Tenebrioides mauritanica**, injury to stored grain by, XI.

Wheat and Corn as food of, XII.

tephrocephala, Tipula, 79.**Termes flavipes**, injuries by, XIII.

terminalis, Lixus, 76.

Thomas, Cyrus, on meadow maggots, 78.

on *Sphenophorus sculptilis*, 61.

on wheat culture and the Chinch Bug, 32, 33.

Reports as State Entomologist of Illinois,
cited, 32, 61, 78.**Thrips tritici**, IX.**Thyreocoris pulicarius**, XII, 51.**Timothy**, 51, 54, 96.

injury to, by meadow maggots, 79, 82.

by snout beetles, 58.

by *Sphenophorus parvulus*, 63, 67.

sculptilis, 62.

sowing with wheat as protection against
Chinch Bug, 52.**Tipula**, 78. See Meadow Maggots.

bicornis, 78, 79, 80, 81.

description, 80.

life history and injuries, 81.

tephrocephala, 79.

Tipulid larva in clover meadow, XI.

injury to meadows, 78, 79.

Tobacco water for Chinch Bug, 39, 56.**Tomato**, injury to, by Variegated Cutworm, 94.**Trampling** by sheep or pigs as measure against
meadow maggots, 83.**Transactions Illinois State Horticultural So-**
ciety cited, 33.

Kansas Academy of Science cited, 59.

Ottawa Field Naturalists' Club cited, 59.

tritici, Thrips, IX.**Trogositide**, XI.**Turkeys** feeding on *Sphenophorus*, 71.**Turnips**, injury to, by meadow maggots, 79.**Turpentine emulsion** for Chinch Bug, 41, 56.**Typha latifolia** food plant of *Sphenophorus*
pertinax, 60.**U****Uhler**, P. R., paper, cited, 61.**uniformis**, Balaninus, 77.**U. S. Commissioner of Agriculture**, Report,
cited, 1, 50, 59, 60, 61, 62, 65, 75, 78.

of Patents, Report, cited, 59.

Department of Agriculture, Bulletin, cited,
33.Division of Entomology, Bulletin, cited,
37.Reports of Entomologist, cited, 62, 70,
75, 78.**Geological and Geographical Survey of the**
Territories cited, 61.

Bulletin, cited, 89.

V**Variegated Cutworm**, 93. See Cutworm, Varie-
gated.venatus, *Sphenophorus*, 61.

versicolor, Iris, 77.

vestigialis, Agrotis, 90.

violans, Nephelodes, 65.

vulpeculus, Mononyctus, 77.

W

- Walsh, E. D., on *Sphenophorus sculptilis*, 61.
 and Riley, C. V., on wheat culture and the Chinch Bug, 32.
 Walsingham, Lord, on *Ctenogenes mortipennellus*, 101.
 Water-melon, injury to, by Cutworms, 84.
 by Western Striped Cutworm, 89.
 Web Worm, Burrowing, X, 98-101.
 Grass or Root, injury to Corn, lawns, and meadows by, IX.
 Web Worms, XI.
 Webster, F. M., Insects Affecting the Corn Crop cited, 69, 73.
 on *Sphenophorus parvulus*, 63, 69.
 sculptilis, 62.
 Weed, C. M., 69, 71.
 on cutworms, 84.
 Western Striped Cutworm, 89. See Cutworm, Western-Striped.
 Wheat as food of *Tenebrioides mauritanica*, XI.
 injury to, by Burrowing Web Worm, 100.
 by Dingy Cutworm, 88.
 by Hessian Fly, X.
 by snout beetles, 58.

- Wheat, injury to, by *Sphenophorus parvulus*, 63.
 sowing Timothy with, as protection against Chinch Bug, 52.
 White Ant, injuries by, XI 11.
 Grub as a Corn insect, XI.
 destruction of beetles of, by light-traps; XI.
 in lawns, XI.
 kerosene emulsion for, XI.
 Wild Buckwheat, infested by Chinch Bugs, 50, 56.
 Williston, S. W., on *Tipula bicornis*, 80.
 Wilson, E. S., on kerosene emulsion for the Chinch Bug, 39.
 W-marked Cutworm, 85. See Cutworm, W-marked.

Y

- Yellow-headed Cutworm, 97. See Cutworm, Yellow-headed.
 ypsilon, *Agrotis*, 85, 93.

Z

- zeæ, *Sphenophorus*, 61.
 Zearing, Louis, on meadow maggots, 83.
 zeellus, *Crambus*, XI.

UNIVERSITY OF ILLINOIS-URBANA



3 0112 018135761